Robin Industrial Engines®

SERVICE MANUAL

Models

EY14, EY18-3, EY23
EY25-2, EY27-2

1193S102

Robin
SUBARU

ROBIN AMERICA, INC.
ROBIN TO WISCONSIN ROBIN
ENGINE MODEL CROSS REFERENCE LIST

ROBIN	WISCONSIN ROBIN
SIDE VALVE	
EY08	W1-080
EY15	W1-145
EY15V	W1-145V
EY20	W1-185
EY20V	W1-185V
EY23	W1-230
EY28	W1-280
EY35	W1-340
EY40	W1-390
EY45V	W1-450V
EY21	EY21W
EY44	EY44W
EY18-3	EY18-3W
EY25	EY25W
EY27	EY27W
OVERHEAD VALVE	
EH11	WO1-115
EH12	WO1-120
EH15	WO1-150
EH17	WO1-170
EH21	WO1-210
EH25	WO1-250
EH30	WO1-300
EH30V	WO1-300V
EH34	WO1-340
EH34V	WO1-340V
EH43V	WO1-430V
TWO CYCLE	
EC13V	WT1-125V
DIESEL	
DY23	WRD1-230
DY27	WRD1-270
DY30	WRD1-300
DY35	WRD1-350
DY41	WRD1-410

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Model		EY14		EY18-3	EY23		EY25-2		EY27-2	
		EY14D	EY14B	EY18-3B	EY23-D	EY23-B	EY25-2D	EY25-2B	EY27-2D	EY27-2B
Type		Air-Cooled, 4-Cycle, Single Cylinder, Horizontal P.T.O. shaft								
Bore x Stroke (in)		62mm x 47mm (2.44" x 1.85")		65mm x 55mm (2.56" x 2.16")	68mm x 62mm (2.68" x 2.44")		72mm x 62mm (2.83" x 2.44")		74mm x 62mm (2.91" x 2.44")	
Piston Displacement (cu in)		142cc (8.66 cu in)		182cc (11.14 cu in)	225cc (13.7 cu in)		252cc (15.40 cu in)		267cc (16.29 cu in)	
Compression Ratio		6.3		6.0	6.5		6.0		6.3	
Output	Continuous	2.5HP/3,600rpm	2.5HP/1,800rpm	3.5HP/1,800rpm	4.5HP/3,600rpm	4.5HP/1,800rpm	5.0HP/3,600rpm	5.0HP/1,800rpm	5.5HP/3,600rpm	5.5HP/1,800rpm
	Max.	3.5HP/4,000rpm	3.5PH/2,000rpm	5.0HP/2,000rpm	6.0HP/4,000rpm	6.0HP/2,000rpm	7.0HP/4,000rpm	7.0HP/2,000rpm	7.5HP/4,000rpm	7.5HP/2,000rpm
Max. Torque		0.67kg-m/3,200rpm	1.34kg-m/1,600rpm	1.86kg-m/1,600rpm	1.14kg-m/3,000rpm	2.28kg-m/1,500rpm	1.3kg-m/3,200rpm	2.6kg-m/1,600rpm	1.4kg-m/3,200rpm	2.8kg-m/1,600rpm
Direction of Rotation		Counter-clockwise, viewed from driving shaft (P.T.O. shaft) side								
Cooling System		Forced Air Cooling								
Valve Arrangement		Side-Valve Type								
Lubrication		Splashing Type								
Lubricant		ENGINE Oil SAE #20, #30 (10w-30 in cotd season)								
Carburetor		Horizontal Draft, Float Type								
Fuel		Automobile Gasoline								
Fuel Consumption Ratio		290g/HP-h at 2.5HP/3,600rpm	290g/HP-h at 2.5HP/1,800rpm	290g/HP-h at 3.0HP/1,500rpm	290g/HP-h at 3.8HP/3,000rpm	290g/HP-h at 3.8HP/1,500rpm	290g/HP-h at 4.5HP/3,000rpm	290g/HP-h at 4.5HP/1,500rpm	320g/HP-h at 4.7HP/3,000rpm	320g/HP-h at 4.7HP/1,500rpm
Fuel Feed System		Gravity Type								
Fuel Tank Capacity		Approx. 25 liters (0.66 U.S. gal.)		Approx. 4.0 liters (1.05 U.S. gal.)			Approx. 5.5 liters (1.45 U.S. gal.)			
Speed Reduction		–	1/2 gear	1/2 gear	–	1/2 gear	–	1/2 gear	–	1/2 gear
Ignition System		Flywheel Magneto								
Spark Plug		NGK B-6HS			NGK BP-4HS		NGK B-6HS			
Lighting Capacity		6V ~ 8V, 15W (Available if required)								
Starting Method		Rope Type (Recoil Starter is available.)								
Dry Weight (lbs.) (Recoil)		13.5 (29.7 lbs)	14 (30.8 lbs)	18.2 (40.2 lbs)	17.5 (38.6 lbs)	18.5 (40.8 lbs)	24.5 (54 lbs)	25 (55.1 lbs)	24.5 (54 lbs)	25 (55.1 lbs)
Dimensions (Recoil)	Length (in)	277mm (10.9")		332mm (13.1")	331mm (13.0")		386mm (15.2")		386mm (15.2")	
	Width (in)	317mm (12.5")		350mm (13.8")	350mm (13.8")		406mm (16")		406mm (16")	
	Height (in)	388mm (15.2")		410mm (16.1")	410mm (16.1")		480mm (18.9")		480mm (18.9")	

2. PERFORMANCE

2-1 MAXIMUM OUTPUT

The Maximum output of an engine is such standard power as developed by that engine, after its initial run-in period with all the moving parts properly worn-in, when operating with the fully open throttle valve. Therefore, it follows that a new engine may not develop this maximum output in the beginning, because moving parts are not in a properly worn-in condition.

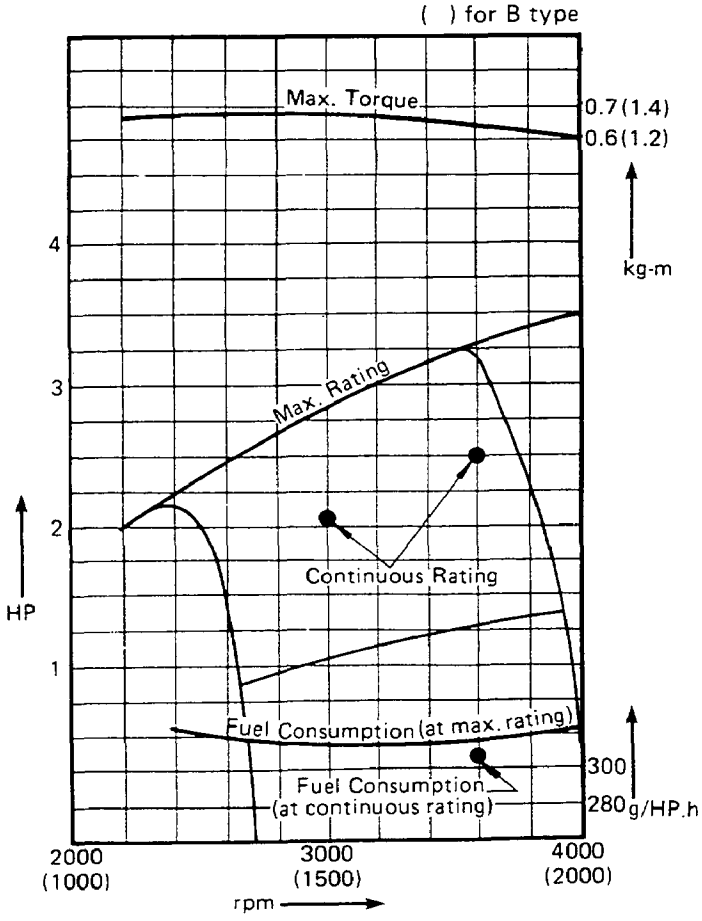
2-2 CONTINUOUS RATED OUTPUT

The continuous rated output of an engine is such power as developed by that engine when running at an optimum speed most favorable from the point of view of engine life and fuel consumption ratio. Therefore, it follows that when designing a driving system for any mechanism, with a model EY14, EY18-3, EY23, EY25-2 and EY27-2 engine, as a prime mover, the continuous power requirement of that mechanism must be kept below the continuous rated output specified.

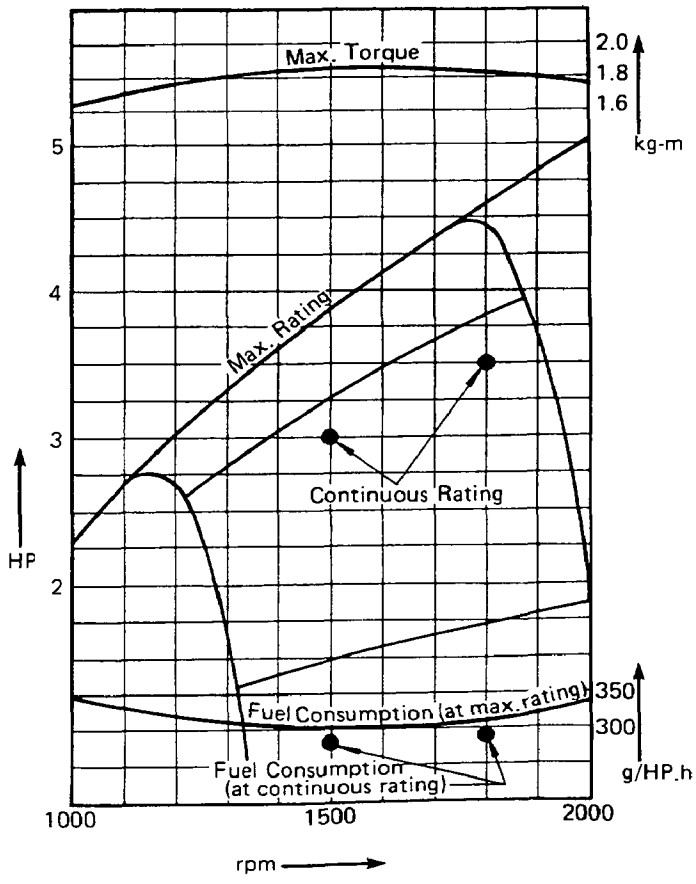
2-3 MAXIMUM TORQUE and FUEL CONSUMPTION RATIO AT MAX. OUTPUT

The maximum torque of an engine is that driving torque of the driving shaft at which the engine is driving an external load, while the engine is developing its max. output. The fuel consumption ratio at max. output is that fuel consumption ratio of an engine while that engine is running at the max. output.

PERFORMANCE CURVE
MODEL EY14

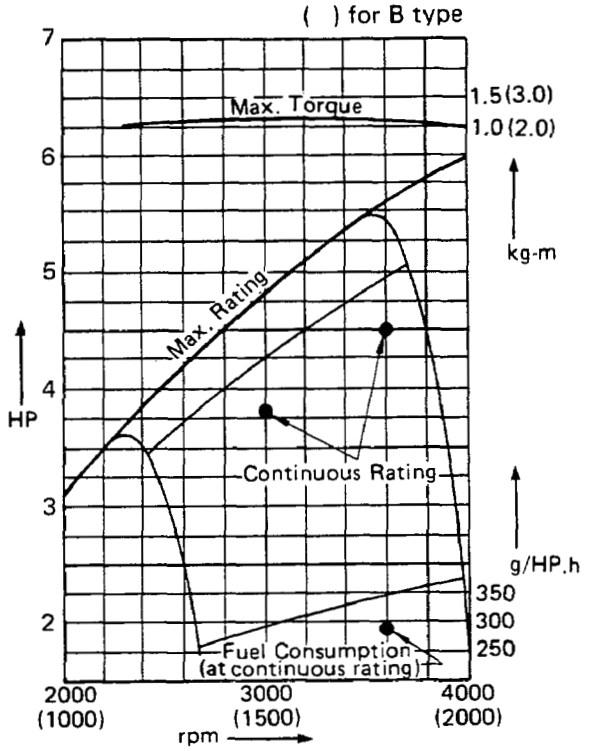


PERFORMANCE CURVE
MODEL EY18-3B



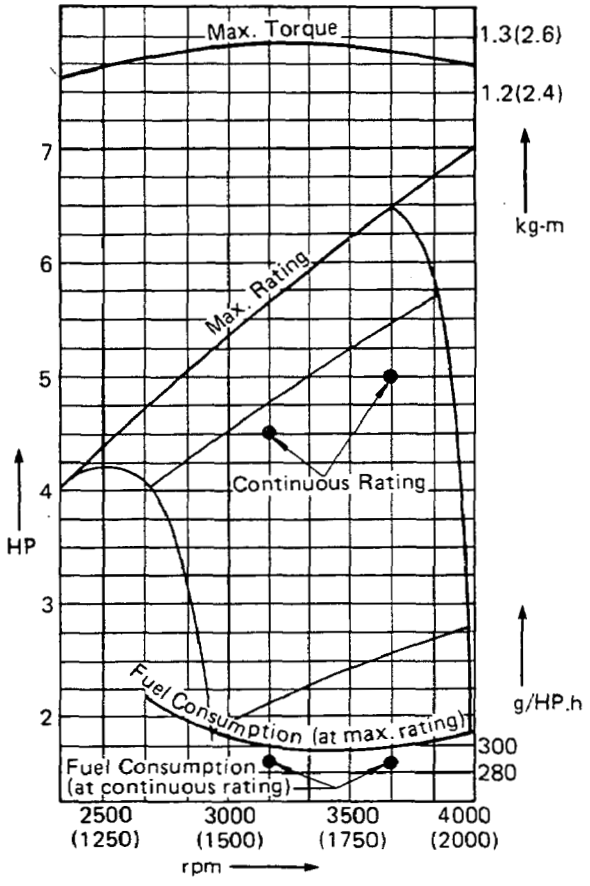
PERFORMANCE CURVE
MODEL EY23

( ) for B type



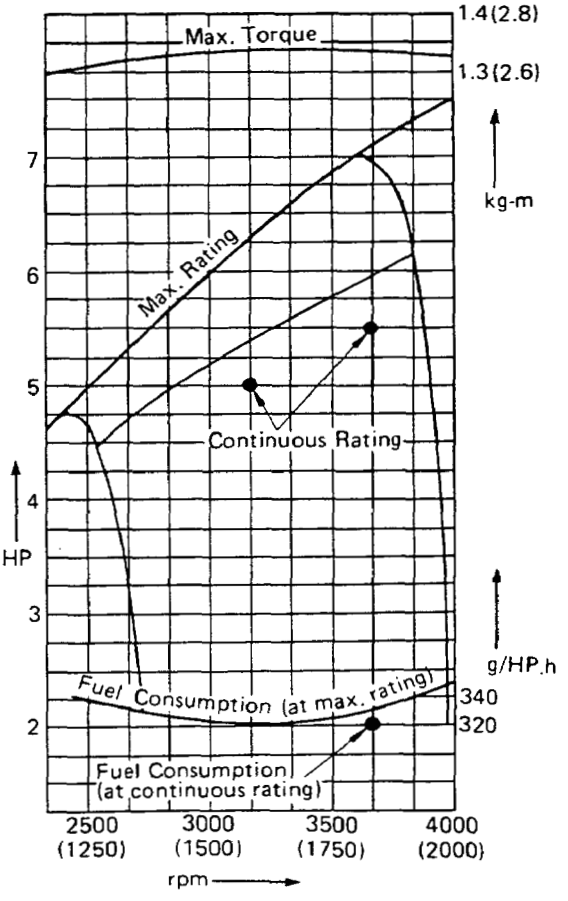
PERFORMANCE CURVE
MODEL EY25-2

( ) for B type



PERFORMANCE CURVE
MODEL EY27-2

( ) for B type



3. FEATURES

1. A compact, lightweight and durable 4-cycle air-cooled engine with high power output, embodying ingenious design technique and advanced production skill.
2. Simple construction, smart appearance, easy start.
3. Reliable power for wide variety of purposes, with smooth speed controll by a governor, under varying load conditions.
4. Economical advantage through low fuel consumption.
5. Great versatility in installation through a 360° belt extension possibility and a two side oil fill and drain arrangement.

4. GENERAL DESCRIPTION of ENGINE CONSTRUCTION

4-1 CYLINDER, CRANKCASE

The cylinder and the crankcase are die-cast as a compact aluminium mono-block piece. The cylinder liner and the valve seats are made of special alloy cast iron and are imbedded in the aluminium casting as inserts. The intake and exhaust ports are located at one side of the cylinder and are also made of inserted pieces in the casting.

The crankcase is separable at the driving shaft side and this separable piece constitutes the main bearing cover.

4-2 MAIN BEARING COVER

As the aluminium die-cast main bearing cover is built onto the crankcase on the driving shaft side, the engine inside are reached for inspection easily by simply removing it. It is also provided with a flange and boss for directly mounting operating machines such as generators and pumps.

There are two oil filters serving also as oil gauges provided at two locations.
(However, in EY18-3 or EY23 engine, at one location in the carburetor side.)

4-3 CRANKSHAFT

The crankshaft is machined from a carbon steel forging with an induction hardened crank pin. On the fan side, the breaker cam is provided and on the driving side, the crankshaft gear is force-fit.

4-4 CONNECTING ROD and PISTON

The connecting rod is machined from an aluminium alloy forging in which the forged alloy itself serves as the bearing metal at both ends. On the large end, an oil scraper for splashing the lubricating oil is provided.

The piston is machined from an aluminium alloy casting and is provided with two grooves for compression rings and one groove for the oil ring.

4-5 CAMSHAFT

The camshaft is machined from a carbon steel forging with integral intake and exhaust cams and is provided with a force-fit cam gear. In the model B engine, the camshaft serves also as the driving shaft, being driven at half the crankshaft speed. In the EY14D, EY23D, EY25-2D and EY27-2D engines, the camshaft is machined from a special alloy cast iron with an integral camshaft gear, and is supported by aluminium bearing metals machined integral with the crankcase at both ends. (no ball bearing is used)

4-6 VALVE ARRANGEMENT

The exhaust valve is positioned in the upstream side of the cooling air with the result that the exhaust valve is intensively cooled for engine life improvement.

4-7 CYLINDER HEAD

A Ricardo type combustion chamber of ample area is employed for good combustion efficiency. The spark plug is mounted obliquely to facilitate fuel tank mounting.

4-8 GOVERNOR

The flyweight type governor effectively operates to maintain the selected speed at varying load.

The model EY14, EY18-3 and EY23 engine is equipped with a separate gearing for the governor to secure better performance.

4-9 COOLING

Cooling is accomplished by a flow of air circulated past the cylinder walls and head fins from a combination fan-flywheel. The air is guided by a cylinder buffle and a head cover. The EY14, EY18-3, EY23, EY25-2 and EY27-2 engines are equipped with curved vane fans made in two modifications, each for direct drive and reduction drive engines.

4-10 LUBRICATION

Lubrication for rotating and sliding parts is accomplished by scooping and splashing the oil in the crankcase with oil scraper attached to connecting rod.

4-11 IGNITION

The ignition system is of the flywheel magneto type with the ignition timing set 23° before T.D.C. The magneto comprises a flywheel, ignition coil and a breaker, of which the flywheel (serving also as a fan) is mounted on the crankshaft and the two other members are mounted directly in the crankcase. (for details, refer to 7. MAGNETO section)

The model EY23 engine normally incorporates an electronic ignition system.

4-12 CARBURETOR

A horizontal draft carburetor is employed. Its setting has been carefully determined after through testing to achieve best starting, accelerating, fuel consumption, output and other performances.

For other details such as construction, refer to 9. CARBURETOR section.

4-13 AIR CLEANER

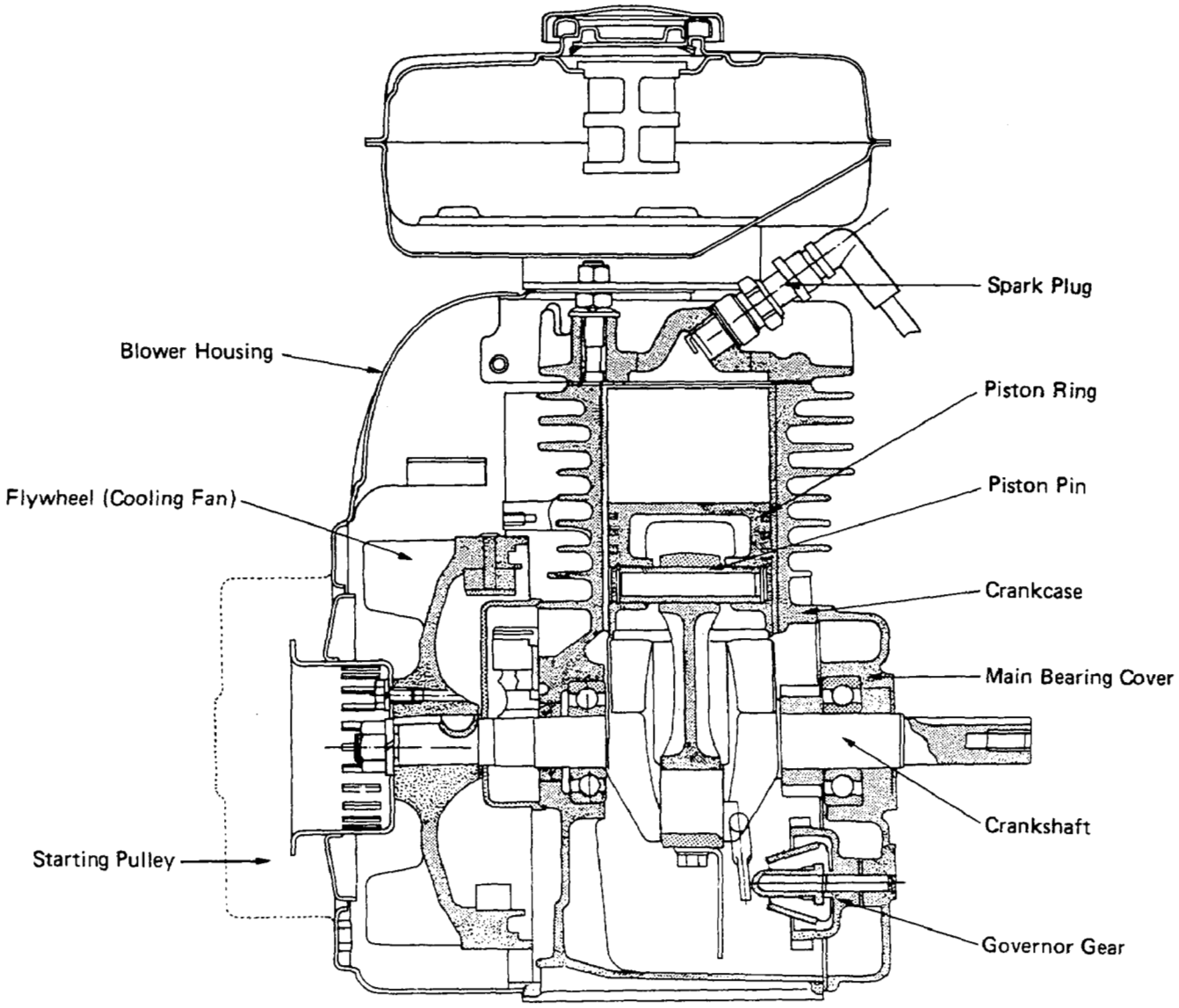
The model EY14, EY18-3 and EY23 engines are equipped with an oval air cleaner incorporating a sponge element.

The cyclone type air cleaner with a semi-wet double element is optional.

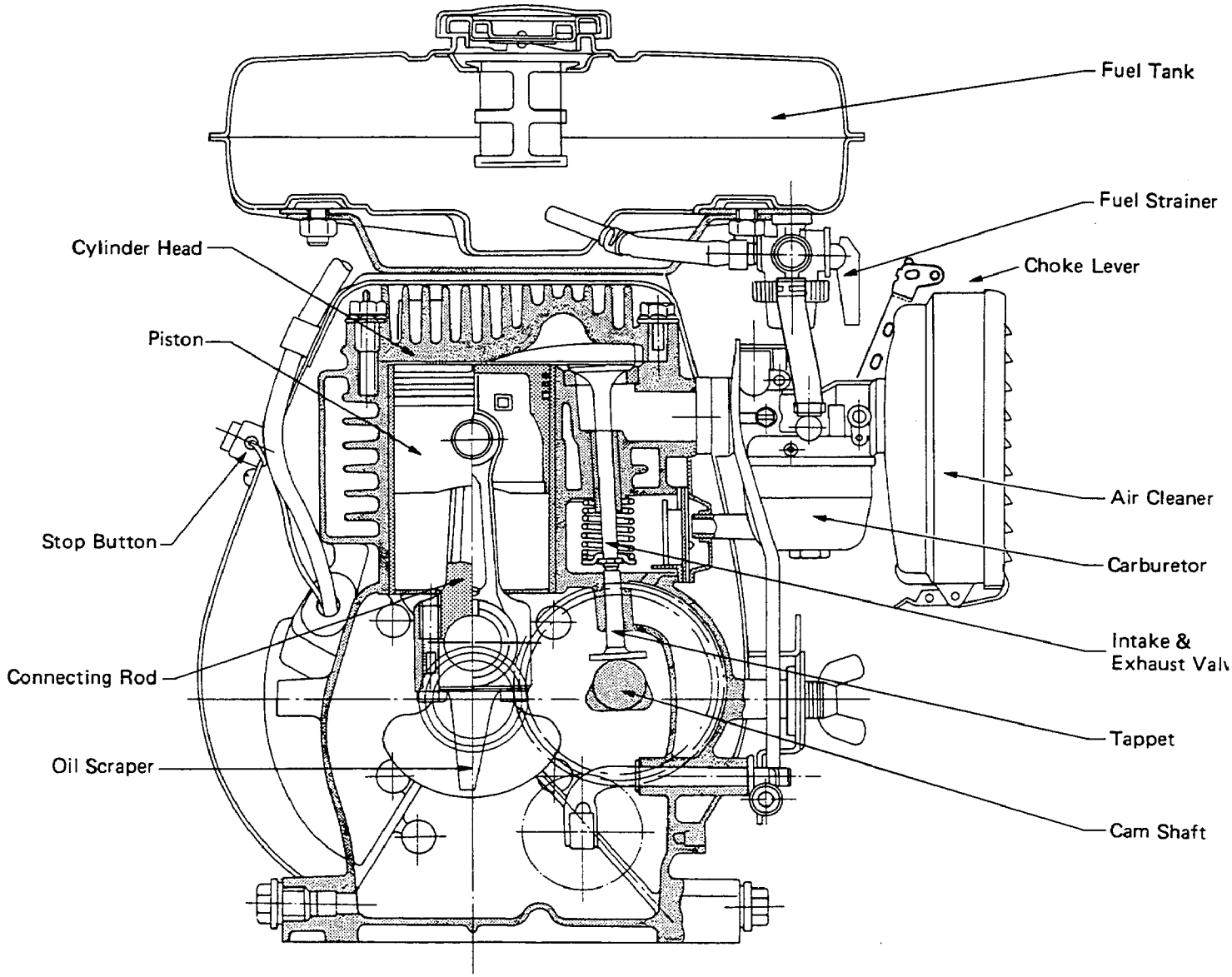
The model EY25-2, EY27-2 engines are equipped with an cyclone type semi-wet double element air cleaner.

4-14 SECTIONAL VIEW of ENGINE

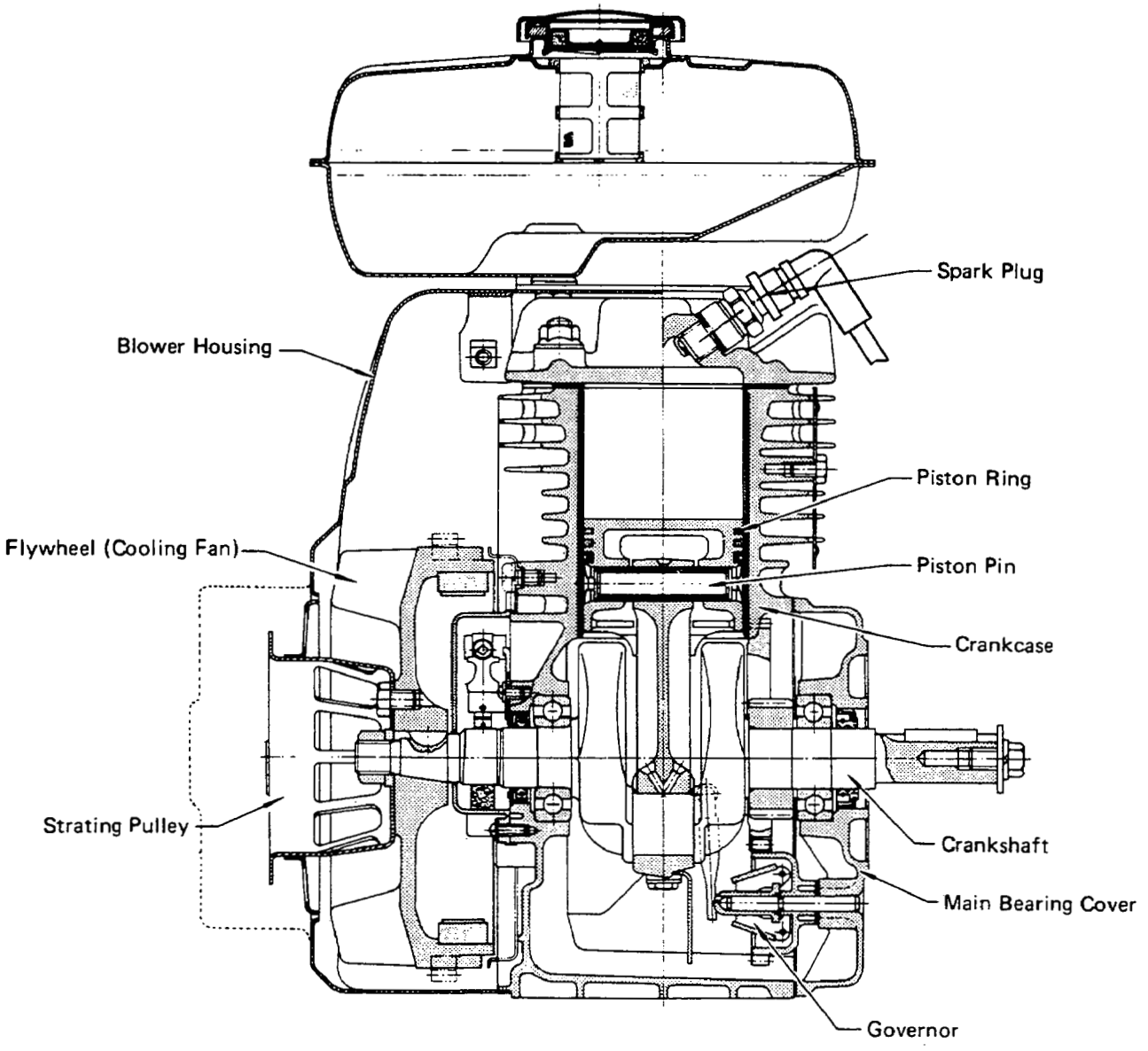
4-14-1 MODEL EY14



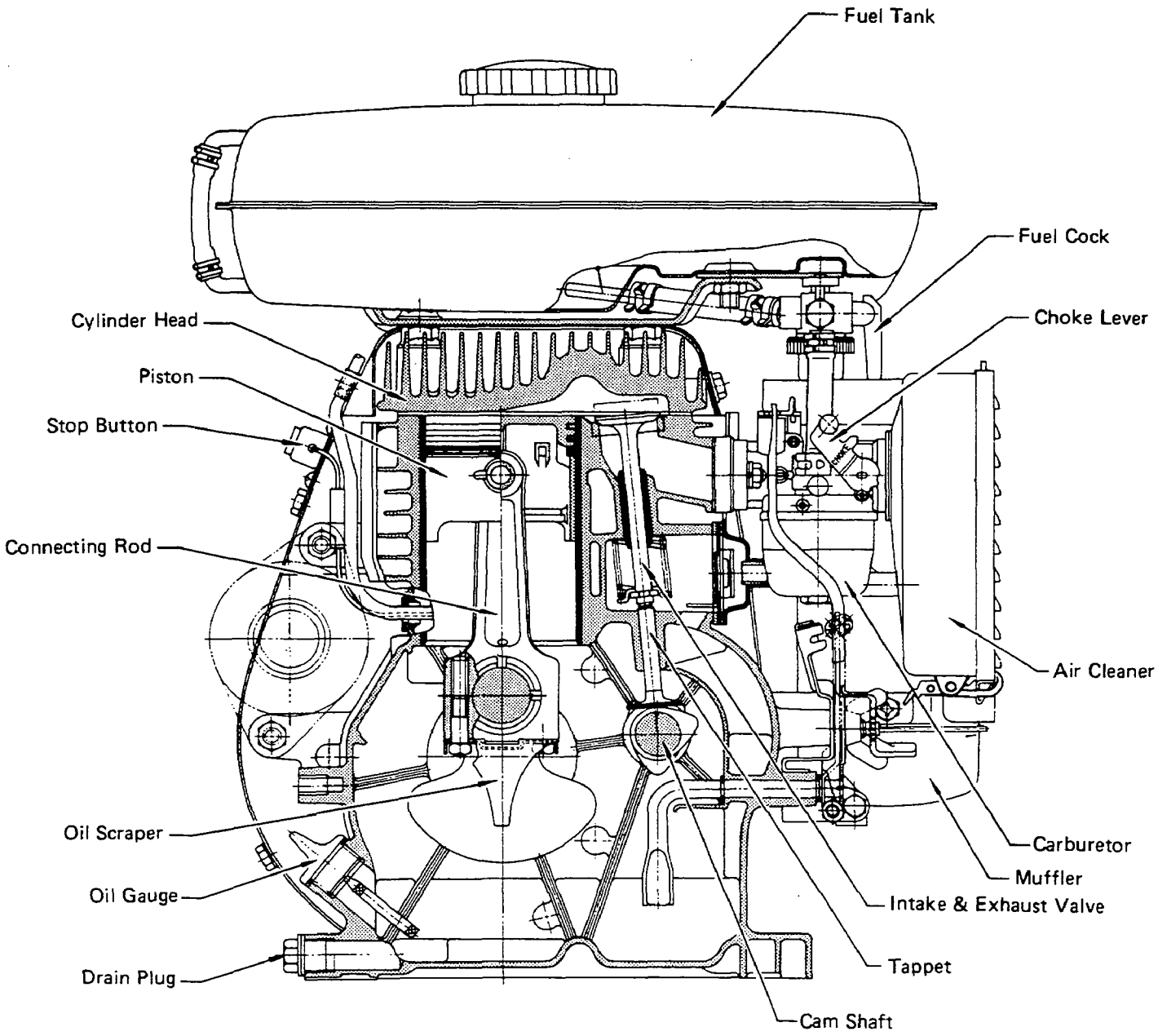
MODEL EY14


Fuel Tank
Fuel Strainer
Choke Lever
Cylinder Head
Piston
Air Cleaner
Stop Button
Carburetor
Intake &
Exhaust Valv
Connecting Rod
Tappet
Oil Scraper
Cam Shaft

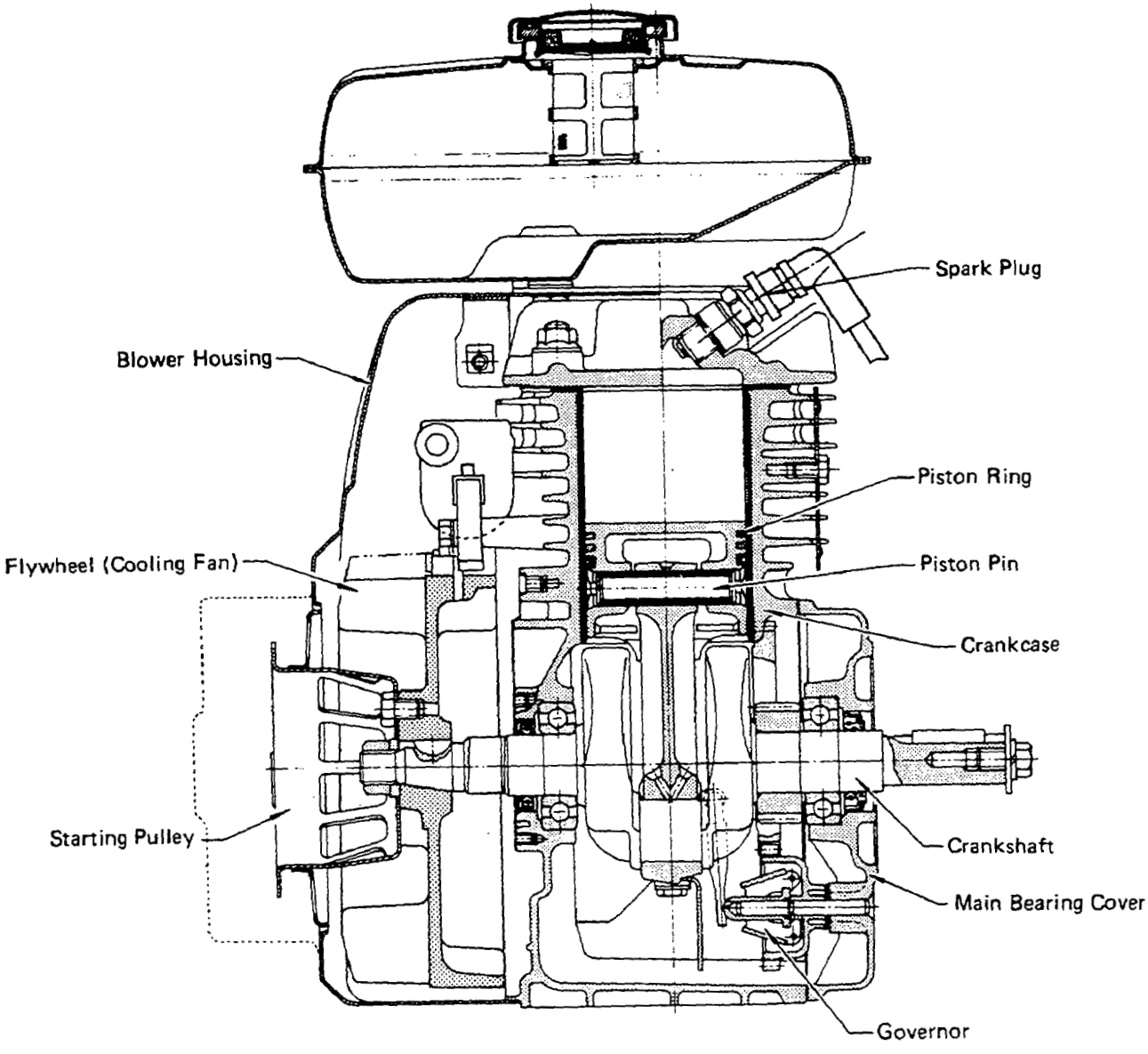
MODEL EY14


Spark Plug
Blower Housing
Piston Ring
Flywheel (Cooling Fan)
Piston Pin
Crankcase
Strating Pulley
Crankshaft
Main Bearing Cover
Governor

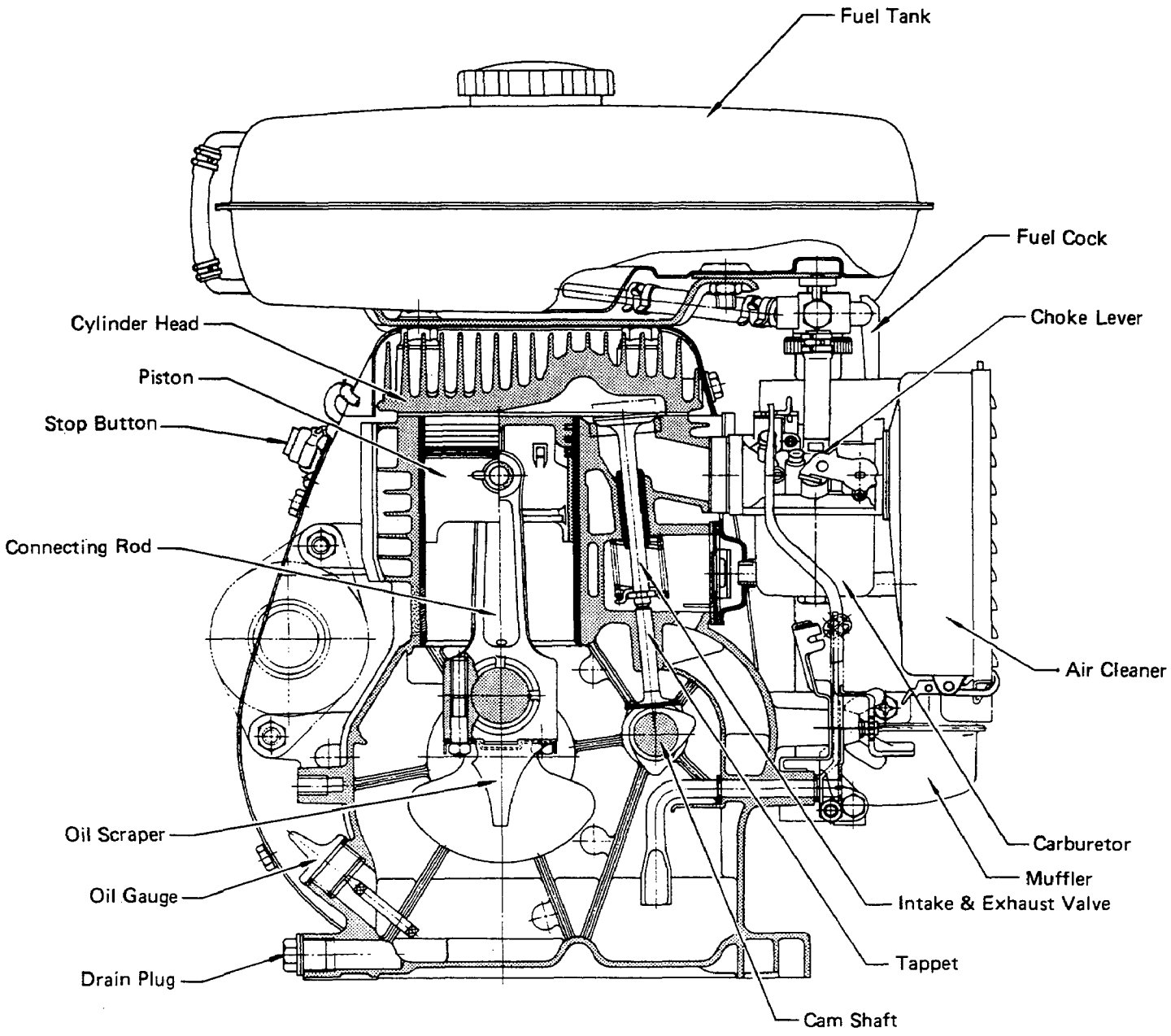
MODEL EY18-3


Fuel Tank
Fuel Cock
Choke Lever
Cylinder Head
Piston
Stop Button
Connecting Rod
Air Cleaner
Carburetor
Muffler
Intake & Exhaust Valve
Tappet
Cam Shaft
Oil Scraper
Oil Gauge
Drain Plug

MODEL EY18-3

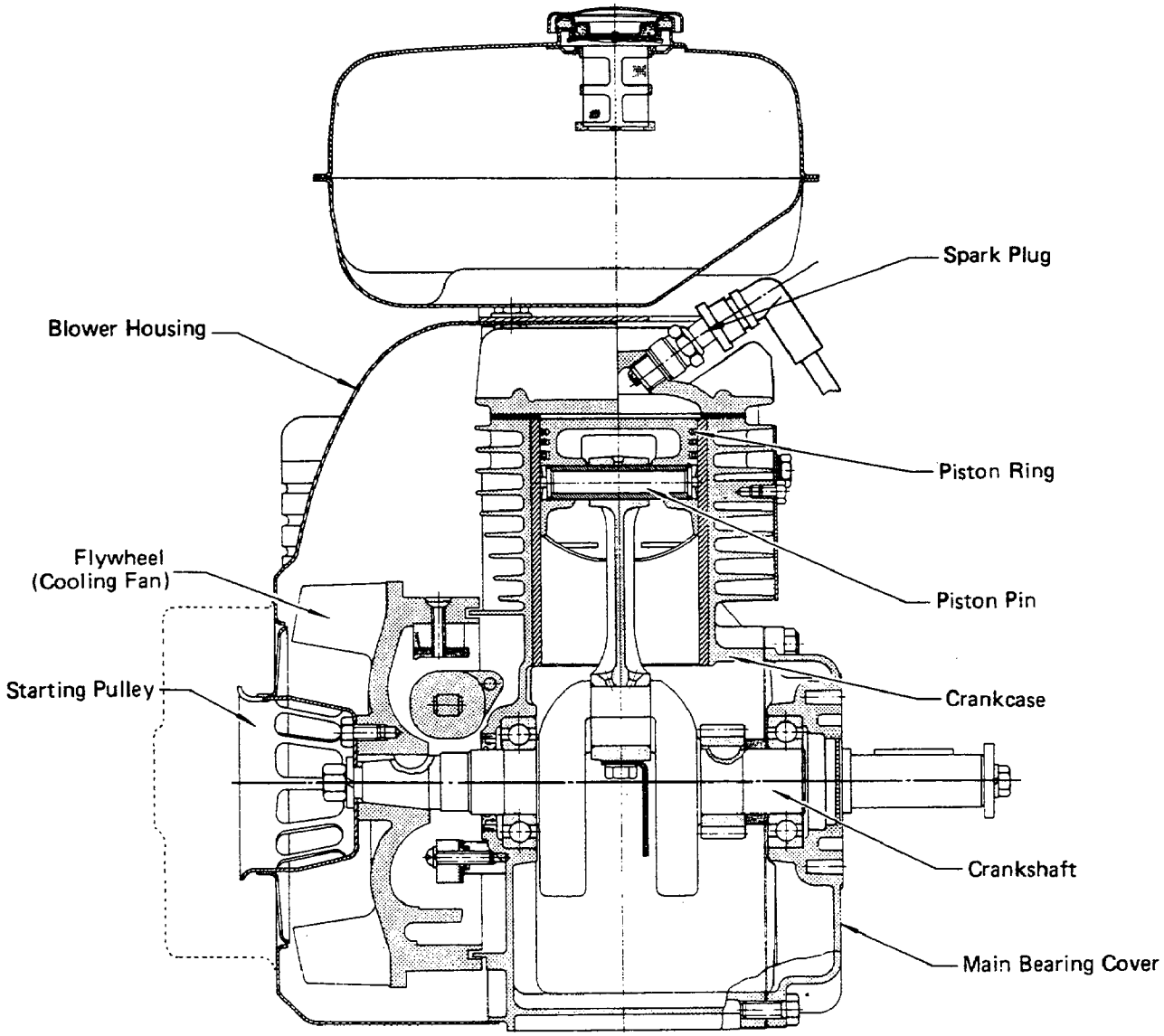

Spark Plug
Blower Housing
Piston Ring
Flywheel (Cooling Fan)
Piston Pin
Crankcase
Starting Pulley
Crankshaft
Main Bearing Cover
Governor

MODEL EY23

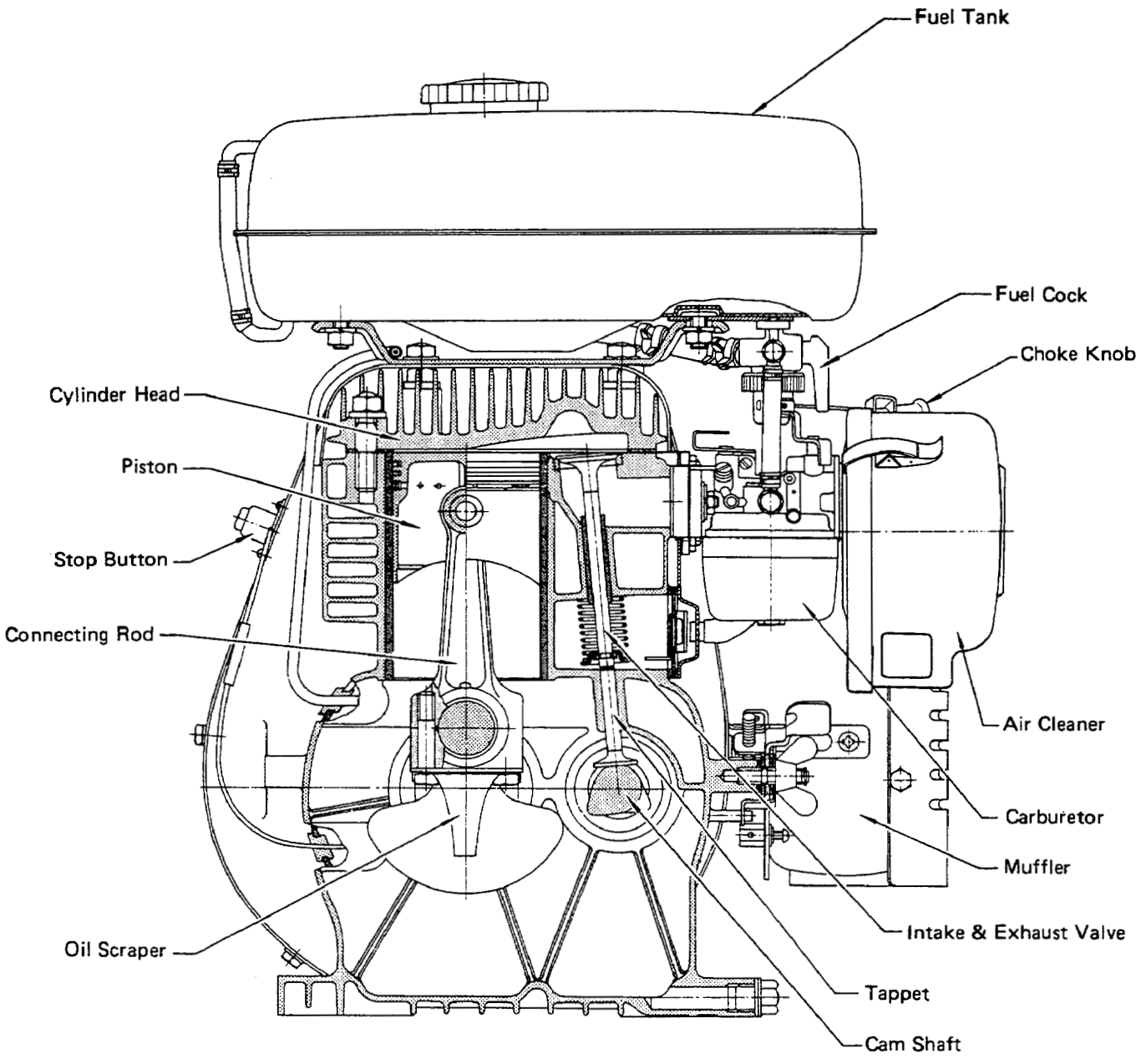

Fuel Tank
Fuel Cock
Choke Lever
Cylinder Head
Piston
Stop Button
Connecting Rod
Air Cleaner
Carburetor
Muffler
Intake & Exhaust Valve
Tappet
Cam Shaft
Oil Scraper
Oil Gauge
Drain Plug

MODEL EY23

4-14-4 MODEL EY25-2 and EY27-2



MODEL EY25-2 and EY27-2



MODEL EY25-2 and EY27-2

5. INSTALLATION

The life, ease of maintenance, frequency of check and repair, and operating cost are greatly affected by the way the engine is installed. When installing the engine, therefore, the following contents must be studied carefully.

5-1 INSTALLING

When installing the engine, its position, coupling conditions with the operating machine and anchoring or supporting method must be carefully studied.

Especially, when deciding the installing position, consideration must be given to facilitate its routines such as filing and checking of gasoline and oil, checking of spark plug and breaker, maintenance of air cleaner and oil draining.

5-2 VENTILATION

The engine must be supplied with fresh air for cooling and fuel combustion. When the engine is to be operated in a cover or in a small room, a proper means must be provided for cooling air re-circulation or ducts and baffle plates for guiding a cooling air, because if the temperature in the engine compartment is allowed to rise, vapor lock, oil deterioration, increase of oil consumption, power reduction, seizure, loss of engine life or other troubles are caused, and proper operation is harmed. The temperature of the engine compartment must be maintained below 50°C even in summer with necessary ventilation arrangement.

5-3 EXHAUST GAS EVACUATION

Since the exhaust gas from the engine is toxic, when the engine is operated indoors, the exhaust gas must be evacuated to outside. Since the output power of an engine is considerably influenced by the length of the exhaust duct, its diameter must be increased in proportion to its length.

5-4 FUEL SYSTEM

When the standard fuel tank is installed separate from the engine, it must be so located that its bottom surface lies within the height of 5 ∿ 50 cm from the fuel joint of the carburetor.

When the fuel tank is installed too low, fuel is not fed properly and if it is positioned too high, the carburetor overflow is caused.

When connecting the fuel pipe, to eliminate air lock and vapor lock, the piping must be carefully examined for heat conductivity, diameter, bending, and leakage through fittings. The standard I.D. of the fuel pipe is 4 ∿ 5 mm.

5-5 POWER TRANSMISSION to DRIVEN MACHINES

5-5-1 BELT DRIVE

Take the following notes into condition:-

- o V-belts are preferred to flat belts.
- o The driving shaft of the engine and the driven shaft of the driven machine must be parallel.
- o The driving pulley of the engine and the driven pulley of the driven machine must be aligned correctly.
- o The driving pulley must be mounted as near the engine as possible.
- o As far as possible, the belt is spanned horizontally.
- o When starting the engine, the load must be disconnected from the engine.
- o If a clutch is not available, a tension pulley or other means must be employed.

5-5-2 FLEXIBLE COUPLING

When a flexible coupling is used, the runout and mis-alignment between the driven shaft and the engine driving shaft must be made as small as possible.

The tolerances on the runout and mis-alignment are specified by each coupling maker.

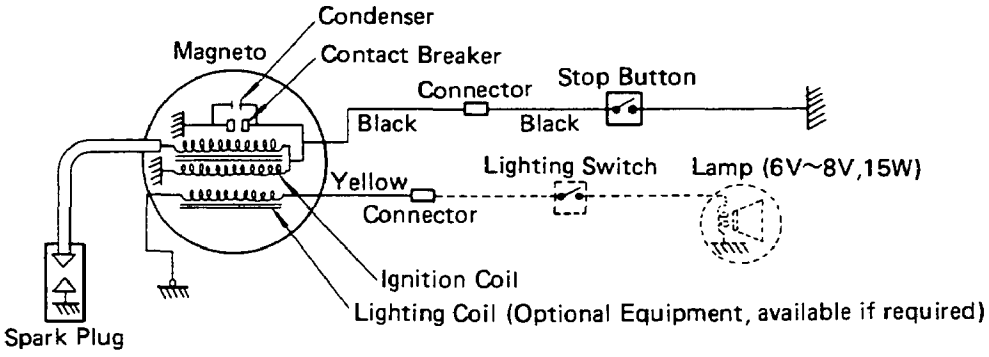
5-6 WIRING

5-6-1 START by RECOIL STARTER, or by ROPE

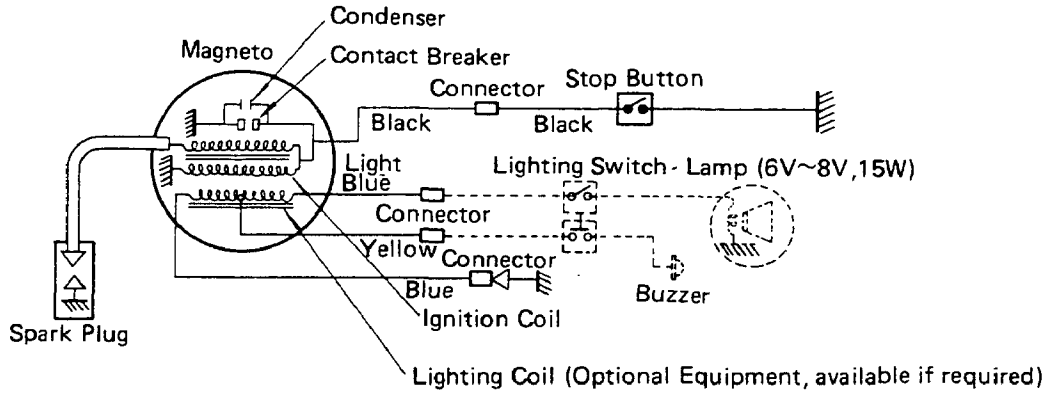
The wiring is indicated in the wiring diagram given below. Normally, the portions indicated by dotted line are not wired in the engine at the factory.

1) Point system

MODEL EY14



MODEL EY18-3



MODEL EY25-2, EY27-2

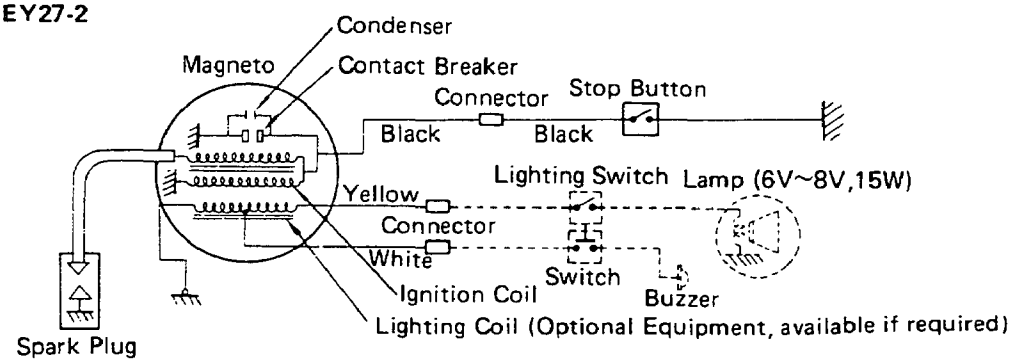


Fig. 5-6-1

2) Electronic ignition system

MODEL EY14: CDI (Capacitor Discharge Ignition) system

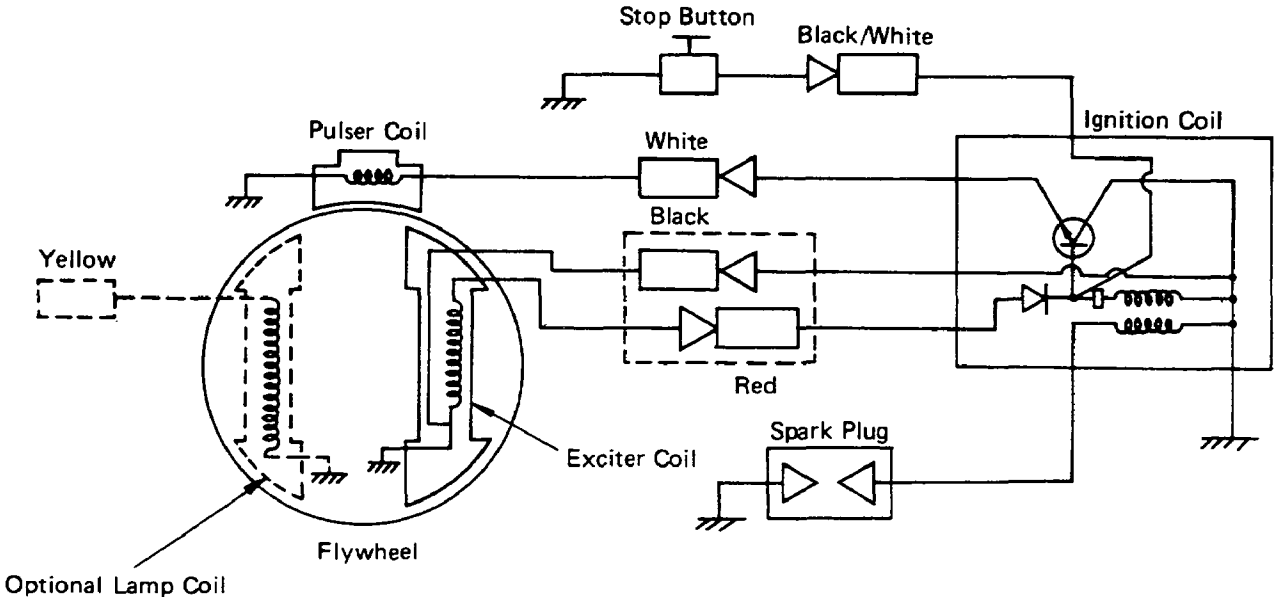


Fig. 5-6-2

MODEL EY23 STD: TIC (Transistor Ignition Circuit) system

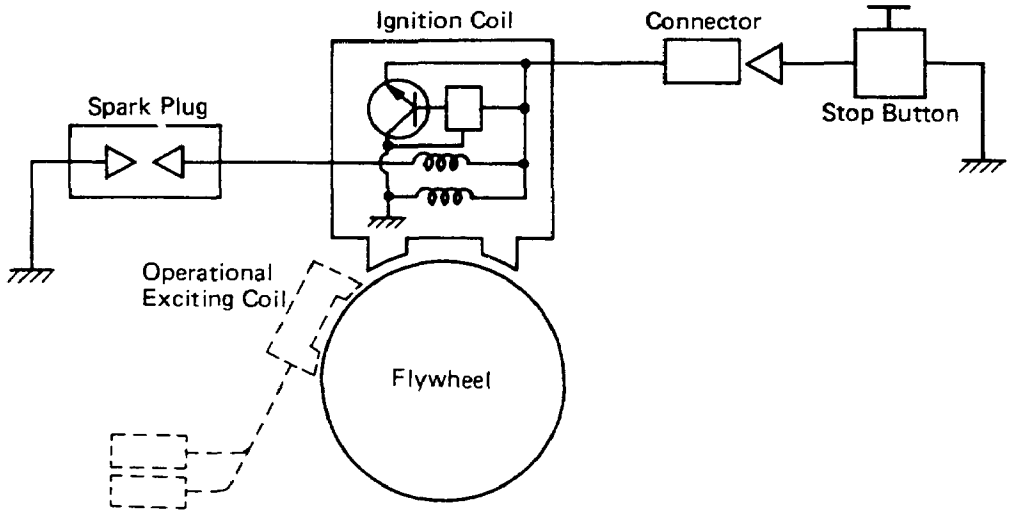


Fig. 5-6-3

MODEL EY23: TIC with Lamp Coil System

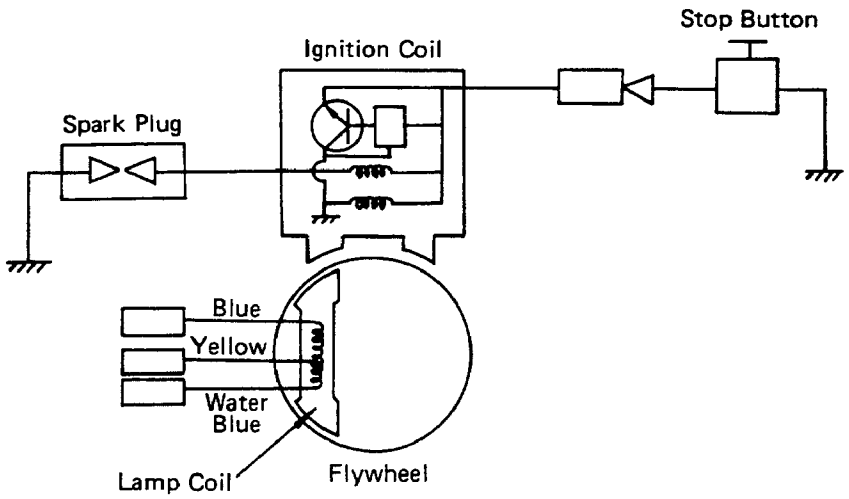


Fig. 5-6-4

MODEL EY25-2, EY27-2: PIT (Pulser Ignition Transistor) system

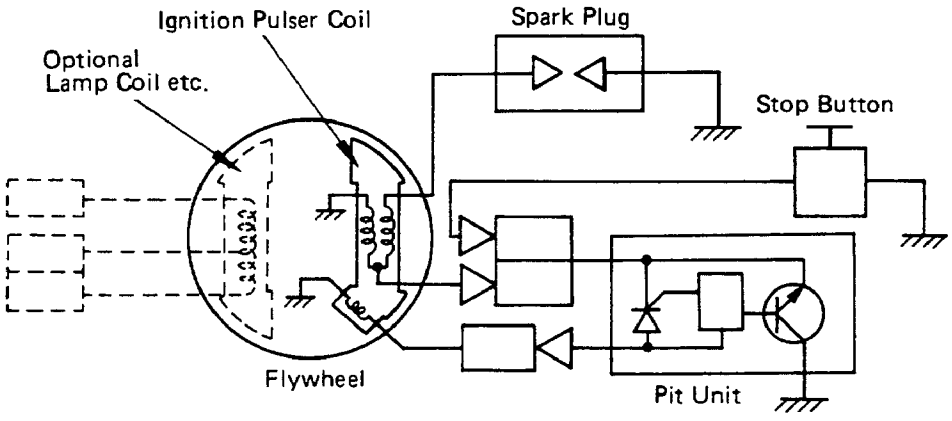
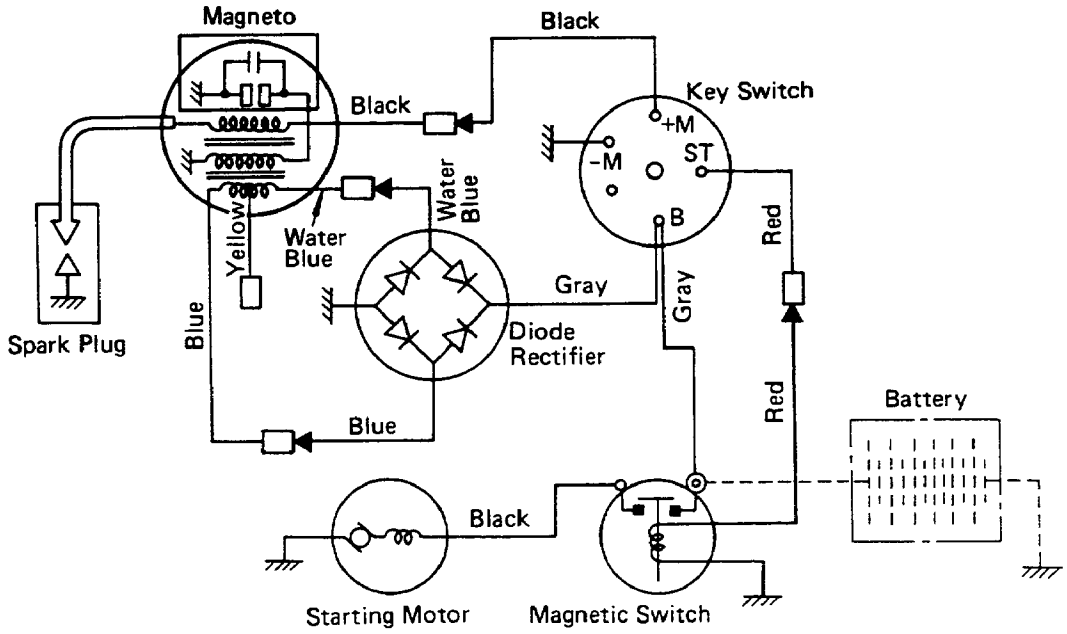


Fig. 5-6-5

5-6-2 CELL START

The wiring is as shown in the figure below. The section, in the figure, described with dotted lines is normally not prepared in the engine side.

MODEL EY18-3, EY25-2, EY27-2: Point with Cell System



EY18-3D, BS Wiring Diagram

JIS CB Female Terminal

JIS CA Male Terminal

JIS LA106 Board Terminal

Fig. 5-6-6

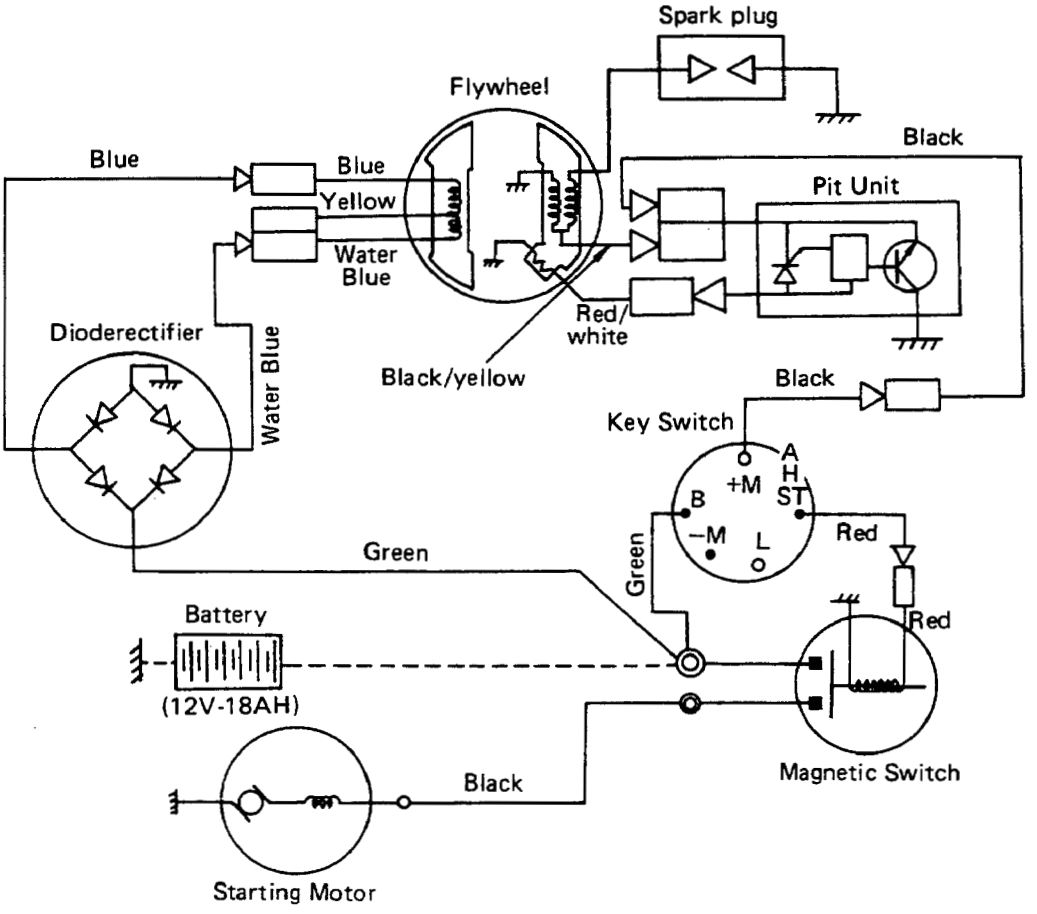

Spark plug
Flywheel
Black
Blue
Blue
Yellow
Water
Blue
Pit Unit
Red/
white
Dioderectifier
Water Blue
Black/yellow
Black
Key Switch
A
H
+M
ST
B
-M
L
Red
Green
Green
Battery
Red
(12V-18AH)
Black
Magnetic Switch
Starting Motor

Fig. 5-6-7

1) Specifications

Parts No.	2147050110 (Model EY18-3BS, 23BS, 25-2BS, 27-2BS), 2147050210 (Model EY23DS, 25-2DS, 27-2DS)
Name	Starting Motor
Manufacturer	HITACHI
Voltage	12V
Output	0.6 kW
Weight	2.5 kg

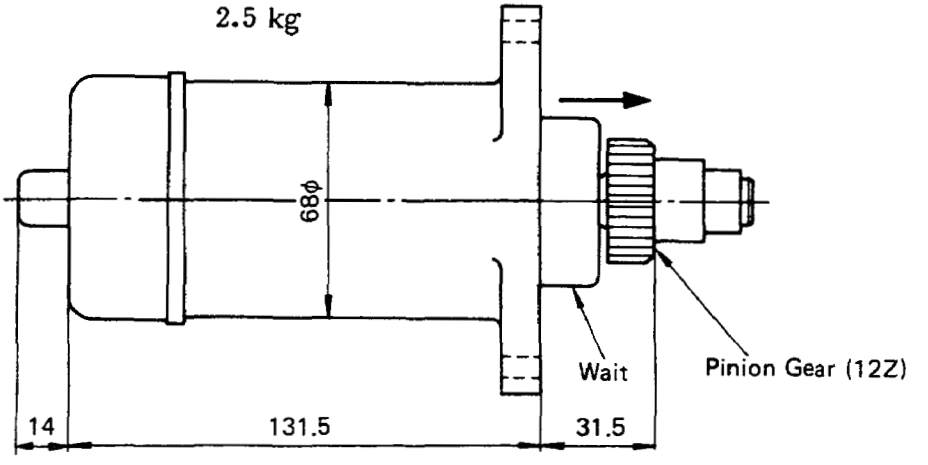


Fig. 5-6-8

2) Operation

The battery is connected to the terminal 6φ of the magnetic switch.

The condition when the starting motor is ON is as shown in the figure below.

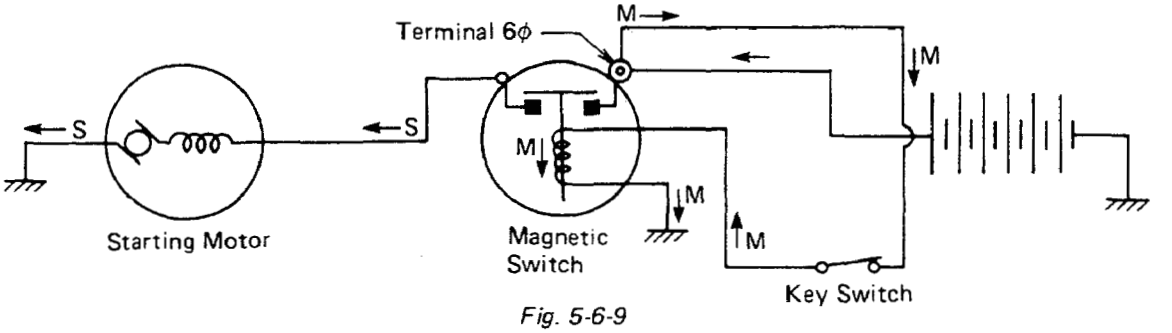


Fig. 5-6-9

This circuit consists of a magnetic switch operating circuit and a starting motor operating circuit.

When the key switch is turned ON, the $\xrightarrow{M}$ circuit is closed, and electricity flows to the direction directed by an arrow, thus the coil of the magnetic switch being excited to absorbe the contact.

Then, power is supplied to the starting motor, and engine cranking is started.

So, low voltage current flows in the $\xrightarrow{M}$ circuit, while starter current for a large current flows in the $\xrightarrow{S}$ circuit.

* Pinion gear engagement

When the starting motor is started, the wait assembled with the helical spline on the shaft is moved to the axial direction by centrifugal force, and push out the pinion gear to be engaged in the ring gear.

6. DISASSEMBLY and REASSEMBLY

6-1 PREPARATION and SUGGESTIONS

1) When disassembling the engine, memorize the locations of individual parts so as to be able to reassemble them correctly. Tag parts if there is a possibility of confusion.
2) Prepare several boxes to keep parts beginning to certain groups together.
3) Group those parts related each other, tentatively assembling where they belong, immediately after removing, in order to prevent missing and misplacing.
4) Handle the disassembled parts carefully and wash them in kerosene.
5) Use the correct tools in the correct way.
6) Standard tools required for disassembling and reassembling:
   a) Work table
   b) Washing pan
   c) Disassembling tools
   d) Washing oil (kerosene or gasoline), Mobile oil
   e) Emery paper, cloth
7) Before starting to disassemble the engine, drain fuel and lubricant. Oil can be drained when the oil drain plug on the crankcase side wall on the carburetor side is unscrewed.
8) Tighten the screws of the cylinder head, main bearing cover, connecting rod, spark plug, and flywheel to the specified torque values.
9) Use new packings and gaskets in reassembly.
10) Immedaitely before assembling parts, wash them in fresh gasoline or kerosene and blow them dry.
11) Apply Mobile oil on rotating and sliding parts.
12) Take care not to contaminate the parts by dust during assembling.
13) Tighten bolts, nuts and screws with proper torque according to the their sizes. If small screws are tightened too tight, they may get broken.
14) After completely assembling the engine, turn it by hand and check if there is any abnormality or loose members.

6-2 SPECIAL TOOLS

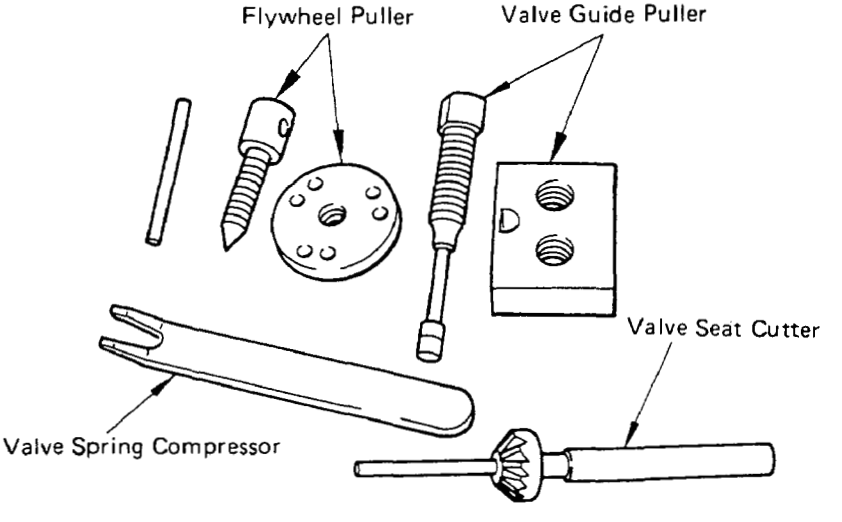


Fig. 6-2

Description	Part No.	Q'ty	Remarks
Flywheel Puller	209 95004 07	1	EY14, EY18-3, EY23, EY25-2, EY27-2
Bolt	001 66085 00	3	
Valve Spring Compressor	207 95003 07	1	EY14, EY18-3, EY23, EY25-2, EY27-2
Valve Guide Puller (Plate, Shaft, Nut)	205 95001 07	1	EY14
	206 95001 07	1	EY18-3, EY23
	207 95001 07	1	EY25-2, EY27-2
Valve Seat Cutter	207 95002 07	1	EY14, EY18-3, EY23, EY25-2, EY27-2

6-3 DISASSEMBLY and REASSEMBLY PROCEDURES

6-3-1 FUEL TANK and FUEL TANK BRACKET

1) Disconnect fuel pipe between strainer and carburetor at carburetor side.
2) Remove fuel tank from bracket. (8 mm nut, 4 pieces) (EY14: 3 pieces)
3) Remove tank bracket from cylinder head (EY14: 8 mm flange nut/EY18-3, EY23, EY25-2, EY27-2: 10 mm flange nut, 4 pieces)

6-3-2 BLOWER HOUSING and HEAD COVER

1) Remove blower housing from crankcase and head cover (cylinder baffle).
(EY14: 6 x 8 mm Flange bolt, 6 pieces/EY18-3, EY23, EY25-2, EY27-2: 6 x 12 mm Flange bolt, 6 pieces)
2) Remove head cover (cylinder baffle) from cylinder head.

6-3-3 AIR CLEANER

1) Remove air cleaner cover and element.
2) Loosen two bolts and remove air cleaner case from carburetor. (EY14: 6 x 8 mm Flange bolt 2 pieces/EY18-3, EY23, EY25-2, EY27-2: 6 x 10 mm bolts, 2 pieces) (EY25-2, EY27-2: at the same time, disconnect choke knob that is connected to carburetor choke lever.)
3) Disconnect breather pipe.
4) In reassembly, wash element in kerosene shaking well until dirt is sufficiently removed. Dry element thoroughly and apply mixture of 4 part kerosene and 1 part Mobile oil. Squeeze out excess oil before reinstalling it.

6-3-4 MUFFLER

Remove muffler from cylinder part of crankcase. (EY14, EY18-3, EY23, EY25-2, EY27-2: 8 mm nut, 2 pieces)

6-3-5 GOVERNOR LEVER and CARBURETOR

1) Remove governor lever from governor shaft. (6 mm bolt, 1 pieces)
2) Remove governor rod and rod spring from carburetor.
3) Remove carburetor from cylinder part of crankcase. (6mm nut, 2 pieces)
In reassembly, refer to 8. GOVERNOR ADJUSTMENT section.

6-3-6 STARTING PULLEY and MAGNETO

1) Remove starting pulley from flywheel. (EY14: 6 x 12 mm bolt/EY25-2, EY27-2: 8 x 12 mm bolt, 3 pieces)

2) Remove flywheel from crankshaft.
Apply a socket wrench over the flywheel nut and give the wrench a sharp blow with a soft hammer. Remove nut and spring washer. (EY14: 12 mm nut/EY18-3, EY23, EY25-2, EY27-2: 14 mm nut)
Attached flywheel puller to flywheel as illustrated in Fig. 6-3-1, turn center bolt clockwise until flywheel becomes loose enough to be removed.
3) Remove spark plug cap from high tension cable of ignition coil and remove ignition coil from crankcase. (6 x 25 mm screw and washer, 2 pieces)
4) Take off the point cover and remove contact breaker and condenser, from crankcase (All models of the EY23 engine are electronically ignited.)

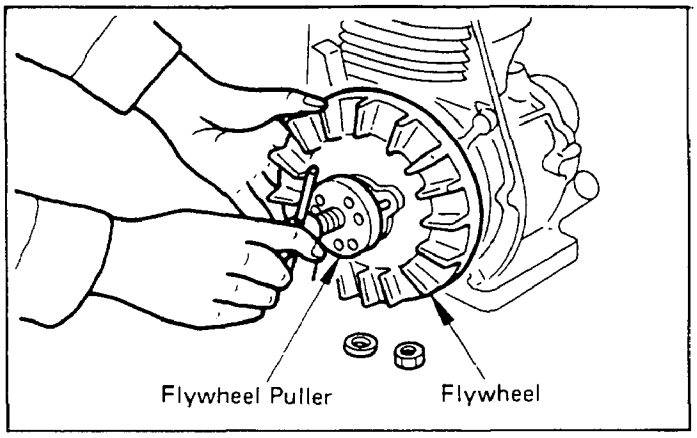


Fig. 6-3-1

5) In reasseambling magneto, refer to 7-2 BREAKER POINT ADJUSTMENT, and 7-3 TIMING ADJUSTMENT.

6-3-7 CYLINDER HEAD and SPARK PLUG

1) Remove spark plug from cylinder head.
2) Unscrew mounting nuts/bolts and remove cylinder head from crankcase. (EY14: 8 mm flange bolt/EY18-3, EY23, EY25-2, EY27-2: 10 mm flange nut)
3) Remove cylinder head gasket and baffle (head cover) from crankcase.
4) In reassembly;

* Clean carbon from combustion chamber and dirt from between the cooling fins of cylinder head. Check its mounting face for distortion. Use new head gasket.
* Torque 8 mm flange bolt in EY14 to 190 ∿ 20 kg-cm (13.7 ∿ 16.6 ft-lb), 10 mm nuts in EY18-3, EY23 to 330 ∿ 360 kg-cm (23.8 ∿ 25.9 ft-lb), and those in EY25-2, EY27-2 to 340 ∿ 370 kg-cm (24.6 ∿ 26.8 ft-lb).
* Leave spark plug out temporarily, for ease in turning engine over for remainder of assembly and for timing adjustments. When mounting spark plug, tighten it to 230 ∿ 270 kg-cm (16.6 ∿ 19.5 ft-lb) torque in models EY14, EY18-3, EY23, EY25-2 and EY27-2.

6-3-8 INTAKE and EXHAUST VALVES

1) Remove tappet cover and breather plate from crankcase.
2) Lift valve spring by means of compressor tool (valve spring compressor) and remove retainer locks and valves. Proceed in the same way both for intake valve and exhaust valve. (See Fig. 6-3-2)
Then, remove valve springs and spring retainers.

CAUTION: DO NOT DAMAGE GASKET SURFACE OF TAPPET CHAMBER WITH THE COMPRESSOR TOOL.

3) In reassembly;

* Clean carbon and gum deposits from the valves, valve seats, ports and valve guides.

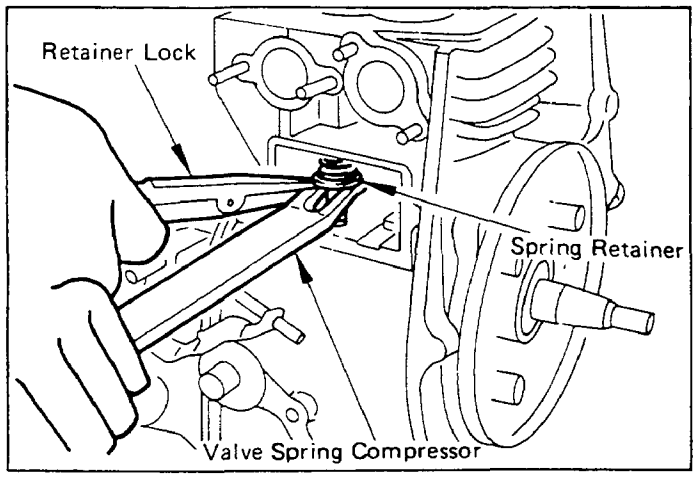


Fig. 6-3-2

* Replace valves if the valve face is pitted or warped.
* Correct the valve seat by using 45° seat cutter tool as illustrated in Fig. 6-3-3. The finished seat width should be 1.2 ∿1.5 mm.
* Valve guides should be replaced when valve stem clearance becomes excessive. (See Fig. 6-3-5) Draw valve guides out using valve guide puller tool as shown in Fig. 6-3-4 and press new guides in, using the same puller tool.
* Assemble valve springs and spring retainers after adjusting tappet clearance.

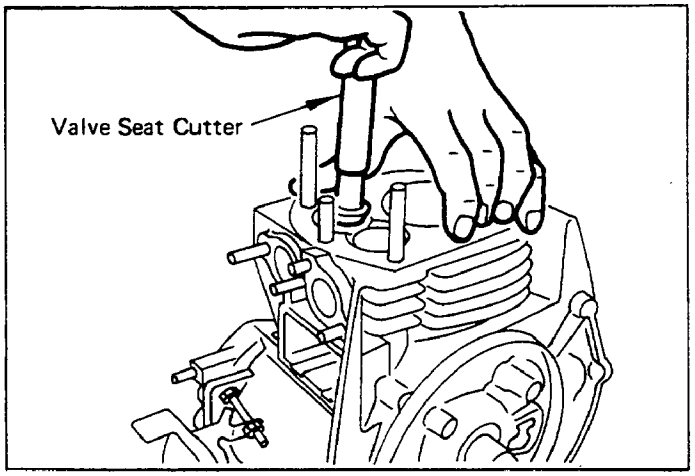
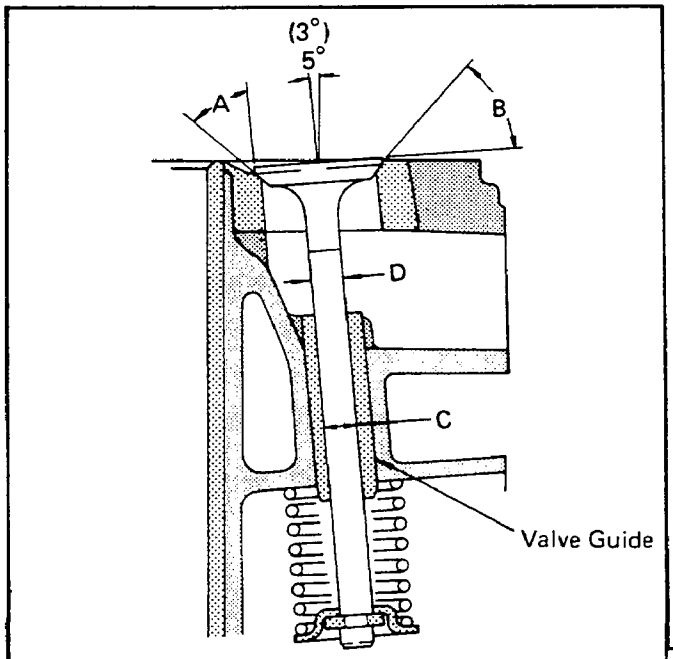


Fig. 6-3-3



( ): EY14

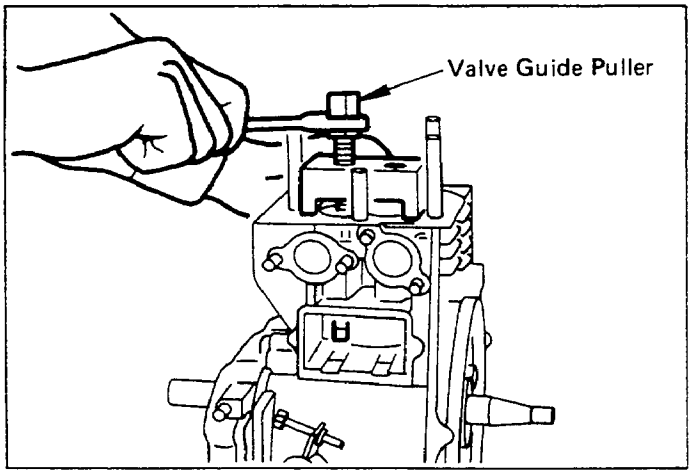


Fig. 6-3-4

		EY14	EY18-3, E23, EY25-2, EY27-2
A – VALVE FACE ANGLE		45°	45°
B – SEAT ANGLE		45°	45°
C – GUIDE INSIDE DIA.		6 dia. $^{+0.015}_{0}$	7 dia. $^{+0.036}_{+0.016}$
D – VALVE STEM DIA.	INTAKE	6 dia. $^{-0.025}_{-0.040}$	7 dia. $^{-0.040}_{-0.062}$
	EXHAUST	6 dia. $^{-0.075}_{-0.095}$	
MAXIMUM ALLOWABLE CLEARANCE BETWEEN C and D	INTAKE	0.025L~ 0.055L	0.056L~ 0.098L
	EXHAUST	0.075L~ 0.110L	

VALVE and VALVE GUIDE CLEARANCE L: Loose

Fig. 6-3-5

4) Tappet Adjustment (See Fig. 6-3-6)
With tappet in its lowest position, hole valve down and insert feeler gauge between valve and tappet stem. The clearance for both intake and exhaust, with engine cold, must be and 0.16 ∿ 0.20 mm for EY14, EY18-3, EY23, EY25-2 and EY27-2. If the clearance is less than it should be, grind the end of valve stem a very little at a time and remeasure.
If the clearance is too large, sink valve seat with seat cutter tool.
After obtaining correct clearance, assemble valve springs and spring retainers, and secure them in place with the retainer locks. Check operation of valves by turning crankshaft over by hand and remeasure tappet clearance.

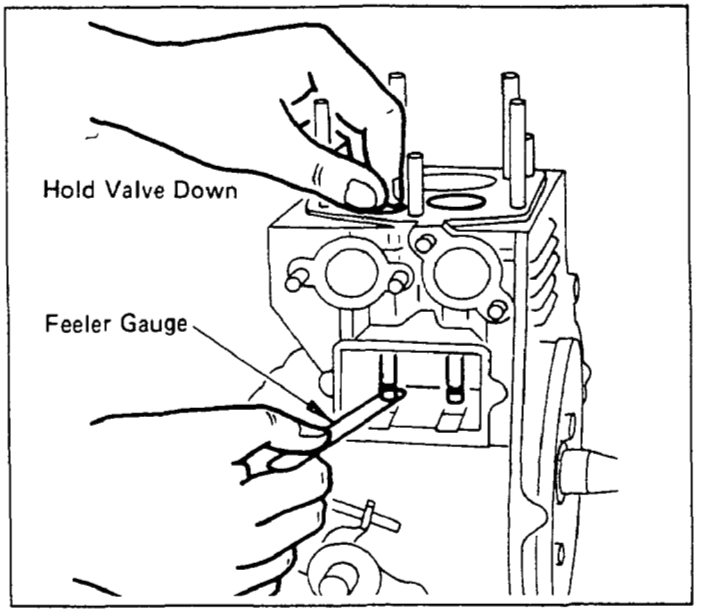


Fig. 6-3-6

6-3-9 MAIN BEARING COVER

Remove mounting screws. (EY14: 6 mm bolt and washer 7 pieces/EY18-3, EY23, EY25-2, EY27-2: 8 mm bolt 8 pieces)
Tap around outer surface of main bearing cover with a soft hammer to break it loose and carefully remove it, so as not to damage oil seal.
In reassembling EY14, EY18-3 and EY23 main bearing cover, install governor gear and governor sleeve inside it first, and make sure that governor shaft is already installed in crankcase. In this case, in order to prevent damage of governor gear (made of plastics) which has been installed inside main bearing cover, reassemble main bearing cover to crankcase, making sure that governor gear mesh with cam gear.
In reassembling EY25-2, EY27-2 main bearing cover, mount governor yoke inside main bearing cover before remounting it. (See Fig. 6-3-7)
If oil seal must be replaced, force fit a new oil seal in main bearing cover before mounting it.
In reassembling main bearing cover, apply oil to bearing surfaces, gear train, tappets and oil seal lips and form a light film of oil on main bearing cover face to hold gasket in place. Mount an oil seal guide on to the crankshaft to prevent damage to the oil seal lips. (Fig. 6-3-8)
Confirm that crankshaft end play is 0 ∿0.2 mm. If necessary, adjust it with adjusting collar. (See Fig. 6-3-9)

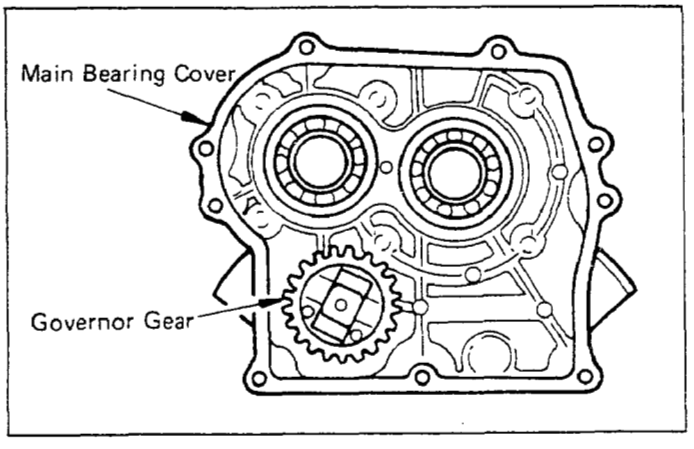


Fig. 6-3-7A (EY14, EY18-3, EY23) (Model B)

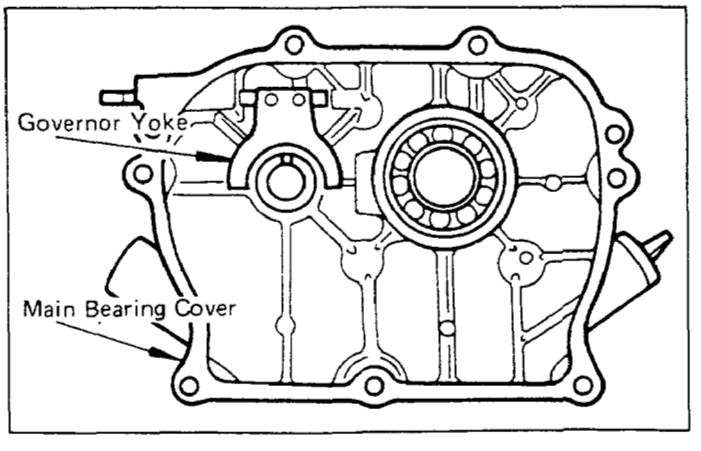


Fig. 6-3-7B (EY25-2, EY27-2) (Model D)

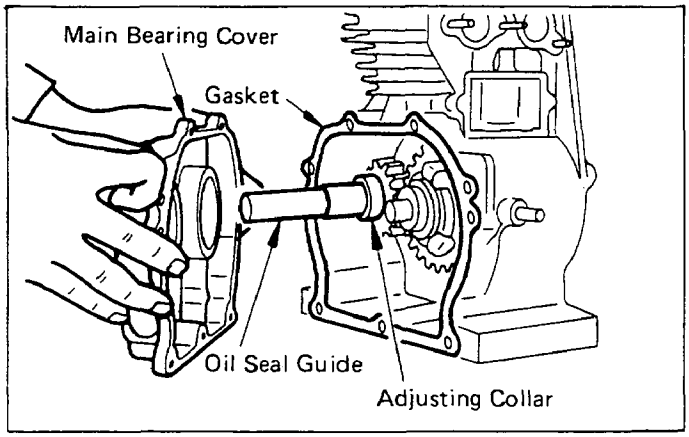


Fig. 6-3-8

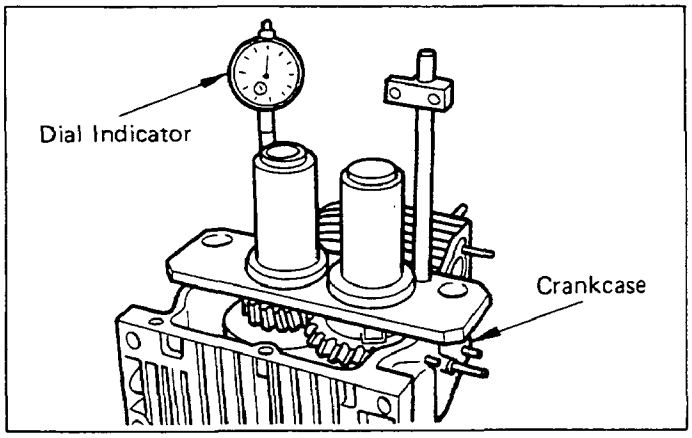


Fig. 6-3-9

* Correct fastening torque for main bearing cover mounting screws is:

EY14	80 ∿ 100 kg-cm (5.7 ∿ 7.2 ft-lb)
EY18-3, EY23, EY25-2 and EY27-2	170 ∿ 190 kg-cm (12.2 ∿ 13.7 ft-lb)

CAUTION: Fig. 6-3-9 SHOWS ONE METHOD OF MEASURING THE CRANKSHAFT END PLAY. THE DISTANCE BETWEEN THE MACHINED SURFACE OF CRANKCASE AND ADJUSTING COLLAR IS MEASURED. THE COMPRESSED THICKNESS OF BEARING COVER PACKING IS 0.25 mm (EY14, EY18-3 and EY23) and 0.15 mm (EY25-2, EY27-2) TAKE THIS THICKNESS INTO CALCULATION WHEN DETERMINING THE END PLAY.

6-3-10 CAMSHAFT and TAPPETS

1) Remove camshaft from crankcase.
   In this case, to prevent tappets from falling out and becoming damaged, turn crankcase over on its side as shown in Fig. 6-3-10.
2) Withdraw tappets and mark them for identification with the hole from which they were removed.
3) In reassembly; *put tappets back in their corresponding hole first and then mount camshaft. Do not forget to mount thrust sleeve on camshaft.
   * Timing marks on camshaft gear and crankshaft gear must be matched up.
   If valve timing is off, engine will not function properly or may not run at all. (See Fig. 6-3-11)

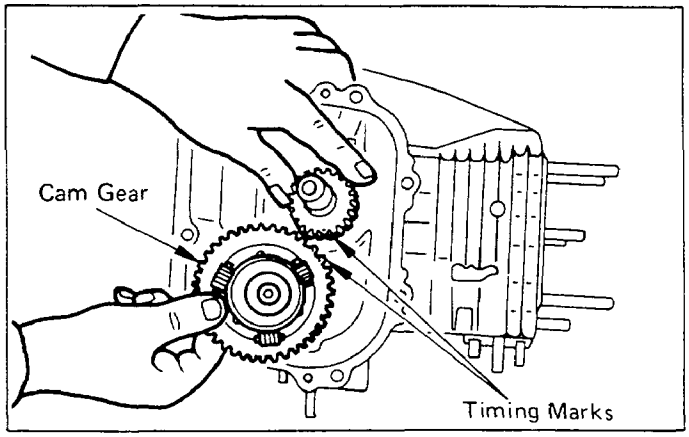


Fig. 6-3-10

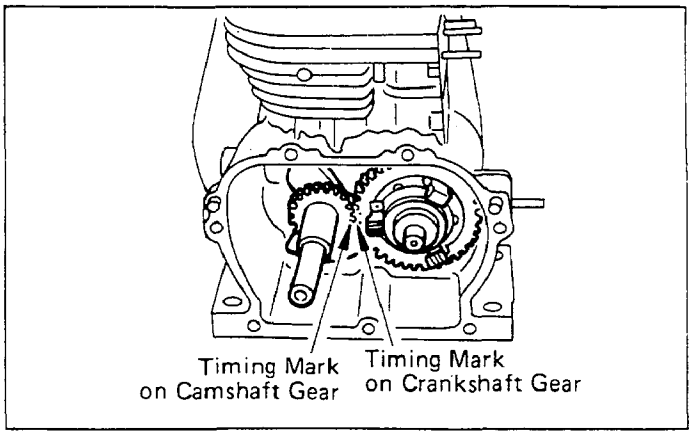


Fig. 6-3-11

6-3-11 CONNECTING ROD and PISTON

1) Straighten out the bent tabs of rod lock washer and remove bolts from connecting rod.
2) Take off oil scraper, rod lock washer and connecting rod cap.
3) Scrape off all carbon deposits that might interfere with removal of piston from upper end of cylinder.
4) Turn crankshaft until piston is at top, then push connecting rod and piston assembly upward and out through top of cylinder.
5) Remove piston from connecting rod by taking out two clips and then removing the piston pin.
6) Remove piston rings from piston by widening the open ends.
7) In reassembly;

a) PISTON RINGS (See Fig. 6-3-12)
If an expander tool is not available, install rings by placing the open ends of the ring on first land of piston, spread ring only far enough to slip over piston and carry it into correct groove.

* Be extremely careful not to distort and brake ring. Assemble rings in the order of oil ring, second ring and top ring. (See Fig. 6-3-13)

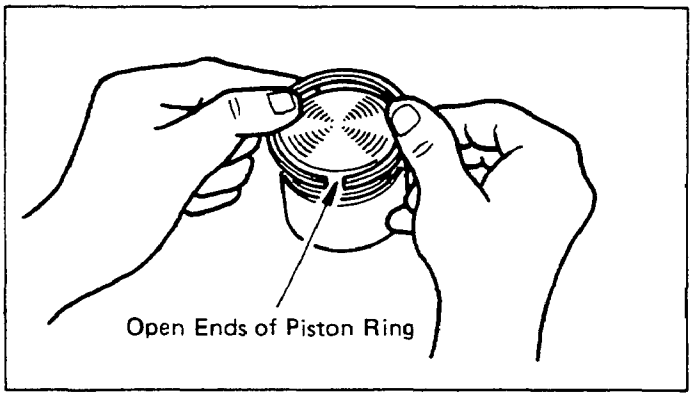


Fig. 6-3-12

b) PISTON and CONNECTING ROD
Assemble piston and connecting rod by inserting piston pin. Be sure to insert clips at both ends of piston pin.

c) When installing connecting rod, use a piston ring compressor as illustrated in Fig. 6-3-14 and position the connecting rod so that the mark on it faces the flywheel side.

* Prior to installing the connecting rod, oil the piston rings, large end bearing and cylinder wall amply.

* Stagger the piston ring gaps 90° apart around the piston.

* To determine the clearance between piston and cylinder, measure the diameter of the piston in the center of the thrust faces at the bottom of the piston skirt.
Turn crankshaft to bottom of stroke and tap piston down until rod contacts crank pin.
Mount connecting rod cap matching the marks on connecting rod.

* Install a new rod lock washer and bend the tabs positively.

* Check for free movement of connecting rod after assembling.

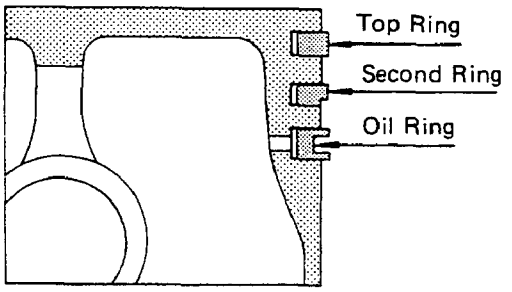


Fig. 6-3-13

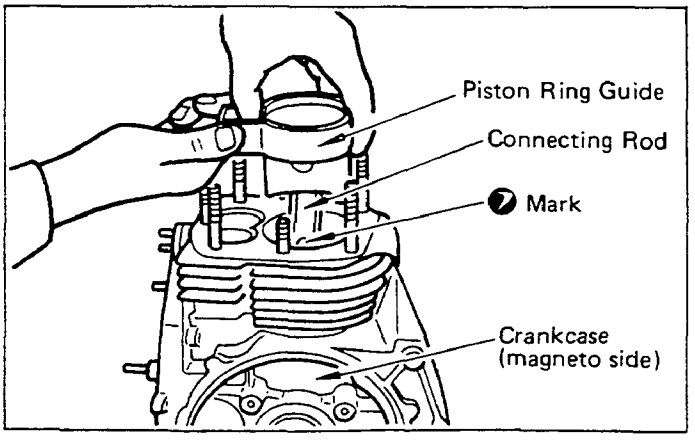
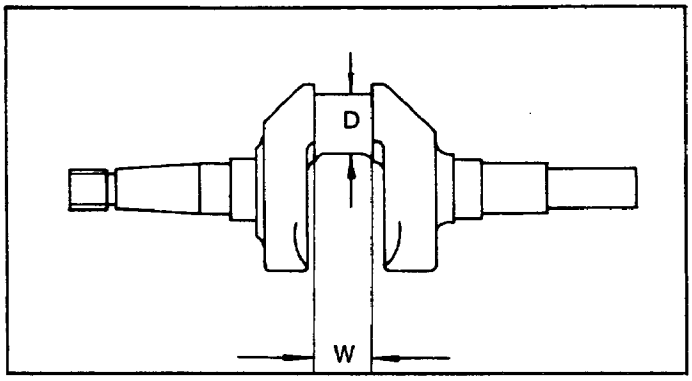


Fig. 6-3-14

The correct connecting rod cap fastening torque values are as follows:

EY14	90 ∿ 115 kg-cm (6.5 ∿ 8.3 ft-lb)
EY18-3 EY23	170 ∿ 200 kg-cm (12.3 ∿ 14.4 ft-lb)
EY25-2 EY27-2	200 ∿ 250kg-cm (14.4 ∿ 18.0 ft-lb)

Refer to chart Fig. 6-3-15 for clearance between piston, cylinder and connecting rod.



		EY14	EY18-3	EY23	EY25-2	EY27-2
D (crankshaft pin Dia)		24 dia. $^{-0.050}_{-0.063}$	26 dia. $^{-0.037}_{-0.050}$	26 dia. $^{-0.037}_{-0.050}$	28 dia. $^{-0.040}_{-0.053}$	28 dia. $^{-0.040}_{-0.053}$
W (crankshaft pin Width)		23.4 ±0.1	25 $^{+0.1}_{0}$	25 $^{+0.1}_{0}$	27 $^{+0.1}_{0}$	27 $^{+0.1}_{0}$
PISTON TO CYLINDER AT PISTON SKIRT THRUST FACE		0.037L~0.075L	0.03L~0.069L	0.03L~0.069L	0.06L~0.99L	0.072L~0.111L
PISTON RING GAP		0.20L~0.40L	0.05L~0.25L	0.05L~0.25L	0.05L~0.25L	0.05L~0.25L
PISTON RING SIDE CLEARANCE IN GROOVES	TOP RING	0.05L~0.095L	0.05L~0.095L	0.05L~0.095L	0.05L~0.095L	0.05L~0.095L
	SECOND RING	0.04L~0.085L	0.04L~0.085L	0.04L~0.085L	0.04L~0.085L	0.04L~0.085L
	OIL RING	0.01L~0.055L	0.01L~0.055L	0.01L~0.065L	0.01L~0.055L	0.01L~0.055L
CONNECTING ROD TO CRANK PIN	DIA.	0.05L~0.076L	0.037L~0.063L	0.037L~0.063L	0.04L~0.066L	0.04L~0.066L
	SIDE	0.2L~0.7L	0.1L~0.3L	0.1L~0.3L	0.1L~0.3L	0.1L~0.3L
CONNECTING ROD TO PISTON PIN		0.01L~0.029L	0.01L~0.029L	0.01L~0.029L	0.021L~0.040L	0.021L~0.040L
PISTON PIN TO PISTON		0.009T~0.01L	0.009T~0.01L	0.009T~0.01L	0.004T~0.015L	0.004T~0.015L

L: LOOSE, T: TIGHT

Fig. 6-3-15

6-3-12 CRANKSHAFT

1) Remove woodruff key (for magneto).
2) Remove crankshaft from crankcase by tapping lightly at its end. Take care not to damage the oil seal.
3) In reassembly; Attach oil seal guide on end of crankshaft and mount crankshaft in crankcase as shown in Fig. 6-3-16.

* If an oil seal guide is not available, mount crankshaft with extreme care so as not to damage lips of oil seal.

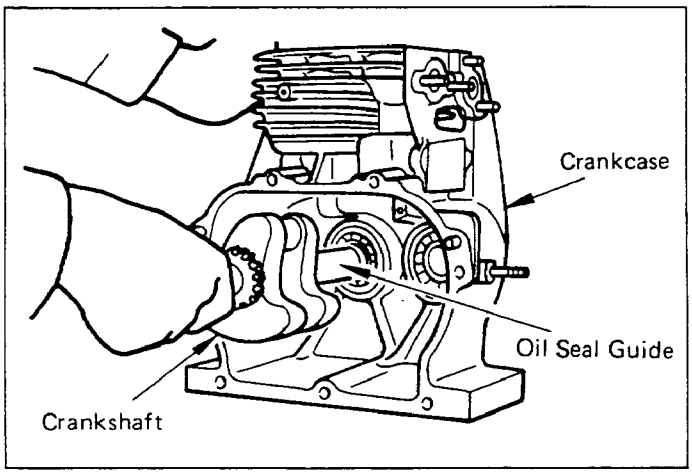


Fig. 6-3-16

7. MAGNETO

7-1 MAGNETO

The spark for ignition is furnished by a magneto in models EY14, EY18-3, EY23, EY25-2 and EY27-2. In these models, magnetos manufactured by KOKUSAN DENKI K.K. are used. (The model EY23 is based on noncontact ignition system.)
The magneto consists of a flywheel, ignition coil, and breaker assembly (including condenser), of which flywheel is mounted on crankshaft and ignition coil and breaker assembly are mounted in crankcase directly.

7-2 BREAKER POINT ADJUSTMENT

The breaker points, which are mounted in the crankcase inside the flywheel should be checked twice a season or whenever the ignition spark becomes weak. If there is evidence of pitting or pyramidding, the breaker points must be corrected, and then it becomes necessary to readjust the gap to its proper clearance. (0.35 mm, 0.014 inch)
The normal breaker point opening is 0.35 mm at full separation. Since the spark timing of 23° is regulated by the point opening, use a timing light to obtain an accurate spark advance.
To adjust breaker point opening, remove starting pulley, blower housing and flywheel from the engine and proceed as follows. (See Fig. 7-2)

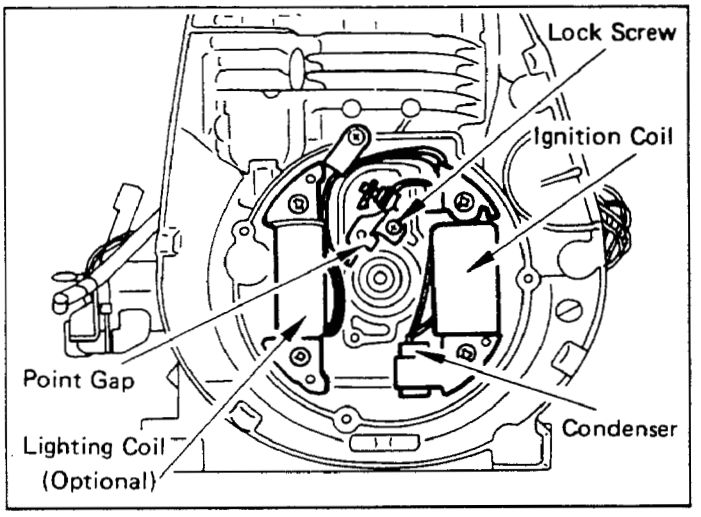


Fig. 7-2-A (EY14, EY18-3)

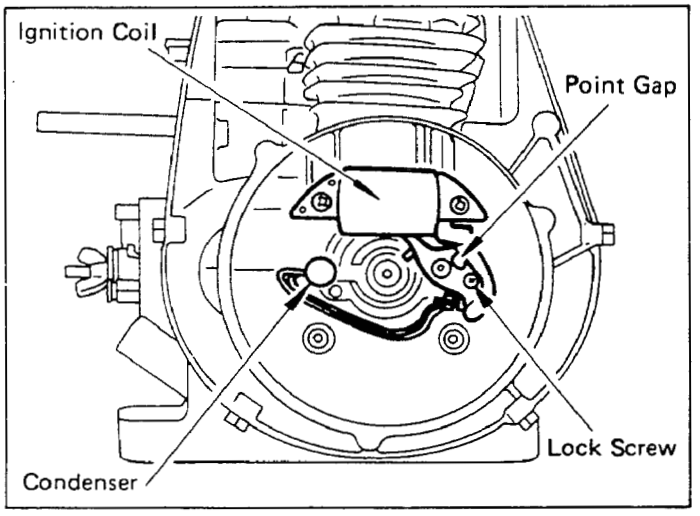


Fig. 7-2-B (EY25-2, EY27-2)

1) Remove breaker cover from contact breaker.
2) Turn crankshaft over until breaker arm comes in contact with the high point of the breaker cam. (maximum point opening of 0.35 mm)
3) Loosen contact support plate lock screw just enough so that bracket can be moved.
4) Insert a 0.35 mm feeler gauge between the points.

CAUTION: ADJUST BREAKER POINT GAP WITHOUT OPENING IT MORE THAN 2 mm, OTHERWISE RATED HEEL-PRESSING FORCE MAY NOT OBTAINED DUE TO THE BENDING OF CONTACT BREAKER ARM.

5) Insert a 0.35 mm feeler gauge between the points.
6) Apply a screw driver to adjusting tab and move the contact support plate just enough so that a slight drag is felt while sliding the feeler gauge from between the points.
7) Tighten lock screw and recheck breaker point gap.
8) Pull a strip of 8 ∿10 mm wide white paper through the closed points to remove oil and dust.

CAUTION: IN THIS CASE NEVER OPEN THE BREAKER POINT GAP MORE THAN 2 mm.

9) Mount flywheel, blower housing and starting pulley on engine after adjustment.

7-3 TIMING ADJUSTMENT

With the Model EY14, EY18-3, EY25-2 and EY27-2 engines, the spark is timed to occur 23° before the piston reaches TDC on the compression stroke. This spark advance of 23° is controlled by the breaker point opening and this advance is obtained when the breaker point opening is adjusted according to the BREAKER POINT ADJUSTMENT to 0.35 mm (0.014 inch). However, the advance timing is more accurately adjusted through the following procedures, using a timing light as shown in Fig. 7-3-1.

For timing adjustment, the following alignment marks are provided.

EY14:	Projection at upper left crankcase
	M mark and slit on flywheel circumference
EY25-2 D & EY27-2 D type:	D mark at lower left crankcase (see Fig. 7-3-2)
	M mark and slit on flywheel circumference
EY25-2 B & EY27-2 B type:	B mark at upper left crankcase
	M mark and slit on flywheel circumference.
EY18-3:	M mark and relief line at upper left crankcase
	M mark and slit on flywheel circumference

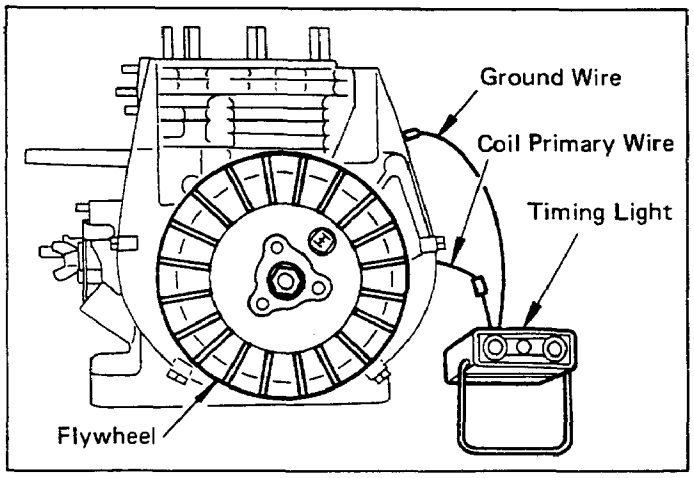


Fig. 7-3-1

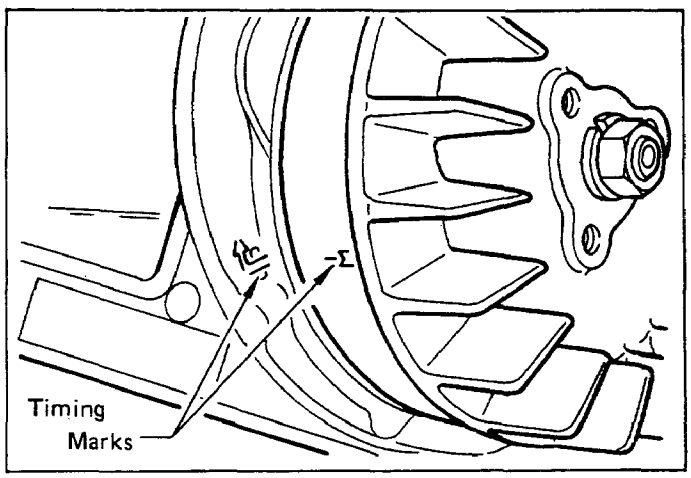


Fig. 7-3-2

For timing adjustment, the following procedures using a timing light:

1) Disconnect the stop button lead wires and the coil primary wire.
2) Remove blower housing from engine.
3) Connect one of the timing light leads to the coil primary wire and ground the other lead to crankcase. (See Fig. 7-3-1)
   While the points are open, the light remains on and when the points are closed, the light is extinguished.
4) Turn flywheel slowly counter-clockwise (D type engines) or clockwise (B type engines) until the light extinguishes.
5) Then, turn flywheel very slowly clockwise (D type engines) or counter-clockwise (B type engines) and stop immediately the moment the light lights up. Check if the slit on the flywheel is in the line with the mark on the crankcase. When the mark line is in alignment, the timing is correct.
6) If the timing mark lines are not in alignment, then re-adjust the point opening according to the BREAKER POINT ADJUSTMENT, by removing the flywheel and repeat the checking procedures 3) through 5).
   After completing the timing adjustment, re-mount the blower housing and connect the coil primary lead to the stop button.

7-4 MAGNETO TROUBLE SHOOTING

When the engine does not start or starts with difficulty, or when its operation is unstable, the following tests will clarify if they are caused by a defect in the magneto.

1) Check ignition cable for possible corrosion, broken, worn insulator or loose connection.
2) Check the sparking as described later in this section.
3) Check if the breaker points require cleaning, or adjusting or not. If the points are badly corroded or pitted. (Condenser may have to be replaced.)
   Refer to "BREAKER POINT ADJUSTMENT".
4) If no spark takes place, replace ignition coil.

* SPARK TESTING

Remove spark plug from cylinder head and place it on blower housing, with the ignition cable connected to it.
Crank the engine several times by starting pulley and observe the spark in the spark gap of spark plug. If the spark is strong, the ignition system can be eliminated as the source of trouble.
If the spark is weak or there is no spark at all, repeat the checks according to the procedures 1) through 3) above. The correct electrode gap is 0.6 ∿ 0.7 mm (0.024 ∿ 0.028 inch).

8. GOVERNOR ADJUSTMENT

In the model EY14, EY18-3, EY23, EY25-2 and EY27-2 engines, a centrifugal flyweight type governor is used. The flyweight assembly is mounted on a separate governor gear in EY14, EY18-3 and EY23 and on the camshaft gear in EY25-2 and EY27-2, and automatically regulate the throttle valve of the carburetor in such a way that the engine speed is maintained constant under varying loads.

1) Connect carburetor throttle lever and governor lever with governor rod and mount governor lever on governor shaft.
2) Connect the governor lever and the rotation adjusting lever with a governor spring, and set the rotation adjusting lever to the crankcase.
3) Turn control lever clockwise (EY14, EY18-3, EY23) or counterclockwise (EY25-2, EY27-2) until throttle valve in carburetor is opened fully. Lock control lever in this position.
4) With a screw driver inserted in the groove of govenor shaft, turn it clockwise (EY14, EY18-3, EY23) or counter-clockwise (EY25-2, EY27-2) fully (until it will not turn any more) and then lock governor lever to governor shaft by tightening clamp bolt.

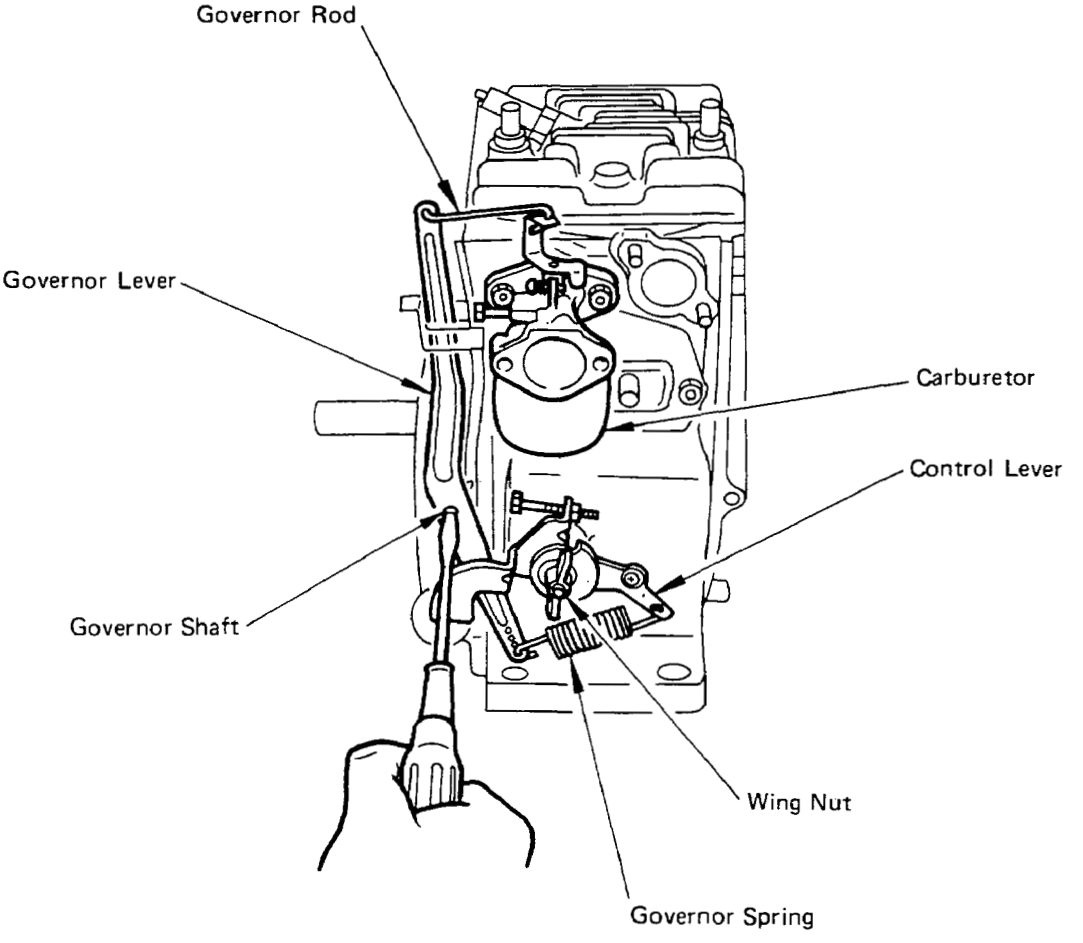


Fig. 8-1

9. CARBURETOR

9-1 OPERATION and CONSTRUCTION (See Figs. 9-1-1 and 9-1-2)

9-1-1 FLOAT SYSTEM

The float chamber located directly beneath the main carburetor structure serves to maintain the fuel level at a constant height by a joint action of the float and the needle valve incorporated in it.

Fuel from the fuel tank enters the float chamber through the needle valve, which is kept open while the fuel level is low but is closed when the fuel level reaches a predetermined level cousing the float to move up.

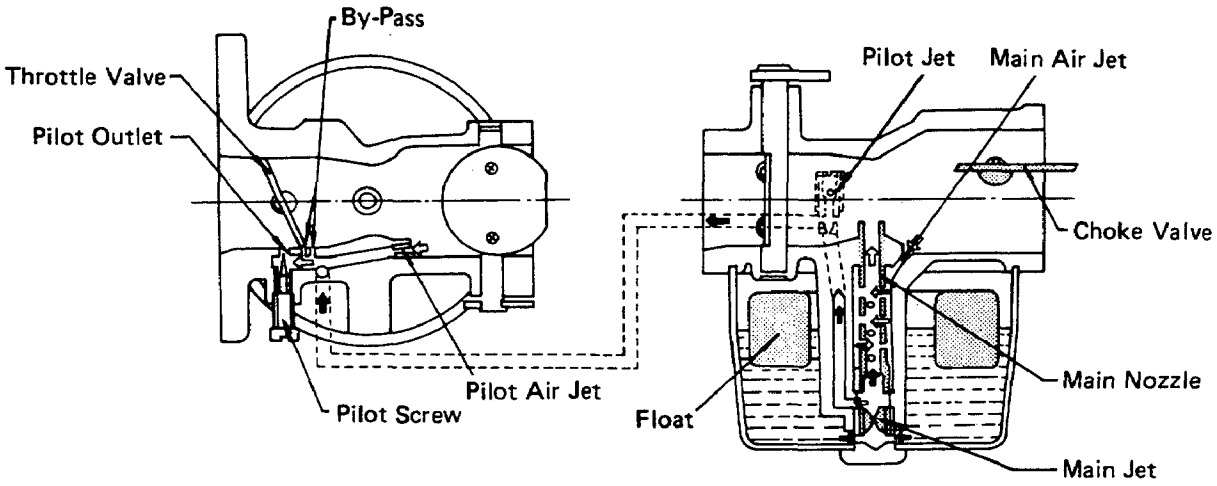


Fig. 9-1-1

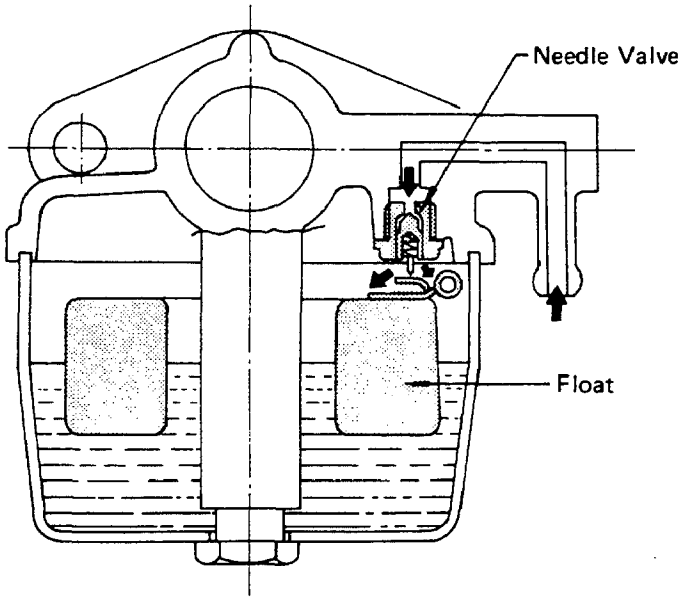


Fig. 9-1-2

9-1-2 PILOT SYSTEM

The pilot system supplies fuel to the engine during idle and low speed operation. The fuel taken through the main jet is measured by the pilot jet to mix with the air measured by the pilot air jet and is then regulated by the pilot screw before being supplied to the engine through the pilot outlet and by-pass.

During idle operation, the engine is supplied with fuel mainly through the pilot outlet.

9-1-3 MAIN SYSTEM

During medium and high-speed operation, fuel supply to the engine is controlled in the main system, in which fuel flow rate is controlled by the main jet. In the main system, fuel is supplied through the main jet where the flow rate is controlled, and through the main nozzle, where the fuel is mixed with air, the flow rate of which is controlled by the main air jet. In the main nozzle the metered air is admitted through the bleed holes to mix with the fuel. The mixture is then discharged through the top of the main nozzle as atomized fuel where it mixes with intake air to become the optimum air-fuel mixture to be supplied to the engine.

9-1-4 CHOKE SYSTEM

The choke system aides starting in the cold season by enriching the air-fuel mixture. When the engine is cranked with the choke closed, the vacuum applied to the main nozzle is made higher so that more fuel is introduced into the air flow to make a starting easy.

9-2 DISASSEMBLY and REASSEMBLY

Besides mechanical failures, most troubles are attributed to an incorrect mixing ratio. The most common causes of incorrect fuel-air mixtures are clogged jets, restricted air and fuel passages, and variations in the fuel level. In order to obtain the full performance of the carburetor, the air cleaner and carburetor must be maintained clean so that air and fuel flow without restriction. (See Fig. 9-2-A, 9-2-B or 9-2-C.)

9-2-1 THROTTLE SYSTEM

1) Unscrew Philips head screw (16) and remove throttle valve (17) and throttle shaft (18). Take care not to damage ends of throttle valve.
2) Remove throttle stop screw (20) to remove spring (19).

9-2-2 CHOKE SYSTEM

1) Unscrew Philips screw (10), remove choke valve (11) and take out choke shaft (12). The model EY25-2, EY27-2 engines have choke ball (24) and choke spring (25) in the carburetor. Remove them beforehand to prevent them from being lost.
2) When assembling choke shaft, the flat on choke valve must be toward the main air jet side.

9-2-3 PILOT SYSTEM

1) Remove pilot jet (23). Use correct tool to prevent damage.
2) Unscrew pilot screw (22) and remove spring (21).
3) Reassembly
   a. Tighten pilot jet firmly to prevent fuel leakage and a possible poor engine performance.
   b. Replace pilot screw if tapered end is diformed. Do not overtighten.

9-2-4 MAIN SYSTEM

1) Remove main jet holder (9) and dismount float chamber bowl (6).
2) Remove main jet (8) from main jet holder (9).
3) Remove main nozzle (2) from carburetor body.
4) Reassembly
   a. Tighten main jet securely to main jet holder. If not tightened securely an engine disorder may result through a too rich fuel mixture.
   b. Tighten main jet holder to 90 kg-cm (6.5 ft. lbs) torque.

9-2-5 FLOAT SYSTEM

1) Extract float pin (5) and remove float (4) and needle valve (14).
2) Reassembly
   Whenever needle valve is replaced, replace valve seat as well, installing a matching needle valve and seat assembly.

CAUTION: NEVER USE A DRILL OR A METAL WIRE TO CLEAN JETS. THEY ARE LIABLE TO DAMAGE THE ORIFICE AND CAUSE AN ENGINE MALFUNCTION. BLOW AIR TO CLEAN THEM.

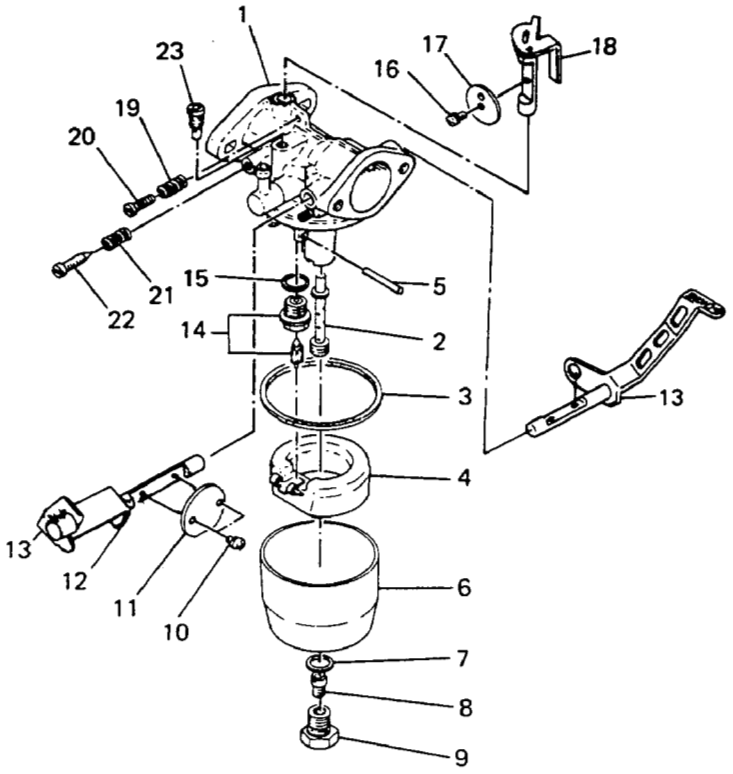


Fig. 9-2-A (EY14, EY18-3)

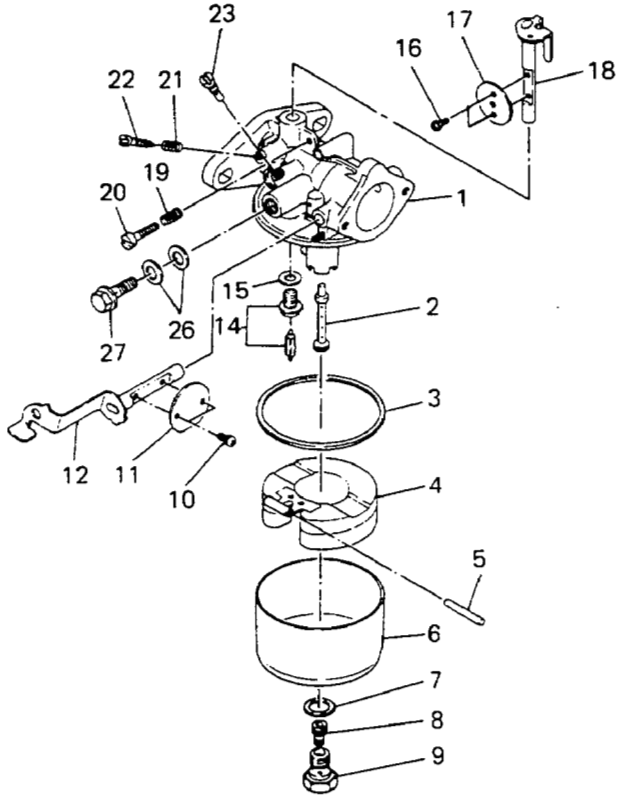


Fig. 9-2-B (EY23)

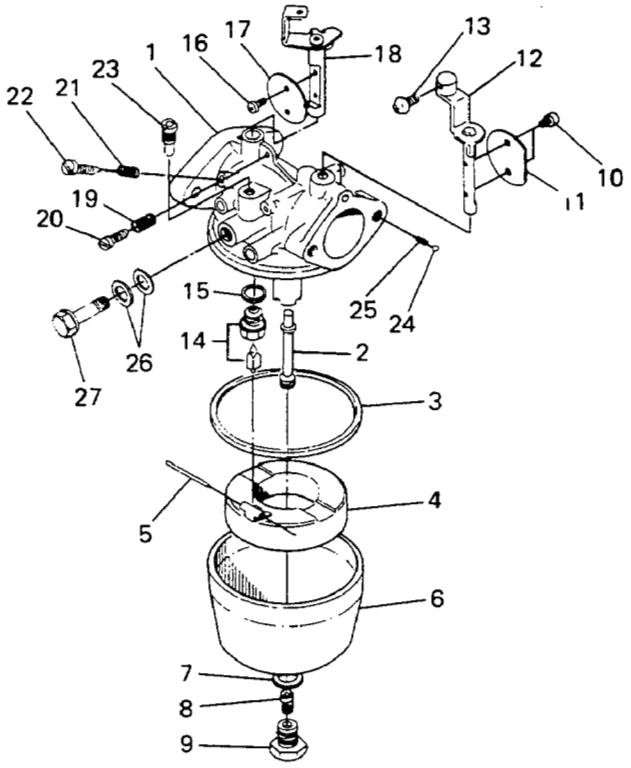


Fig. 9-2-C (EY25-2, EY27-2)

9-3 ADJUSTMENTS

1) Pilot screw is adjusted by back screwing (counter-clockwise) after closing it fully once.

EY14		1 turn
EY18-3	BV18	2 turn
	BV21	1 turn
EY23	BV21	1-3/8 turn
EY25-2	BV24	1-5/8 turn
EY27-2	BV24	1-1/2 turn

CAUTION: DO NOT OVERTIGHTEN PILOT SCREW WHEN CLOSING IT FULLY. THE NEEDLE POINT MIGHT BE DAMAGED BY OVERTIGHTENING.

2) Turn throttle stop screw clockwise until the specified idling speed of 1200 $^{+100}_{0}$ rpm is obtained.
When the idling speed is higher than 1200 $^{+100}_{0}$ rpm turn it counter-clockwise.

3) Make final adjustments to the pilot screw and throttle stop screw with air cleaner mounted and engine at a normal operating temperature.

10. RUN-IN OPERATION of REASSEMBLED ENGINE

An overhauled engine must be carefully run-in to get proper surface condition on newly installed parts.

Especially when cylinder, piston, piston rings or valves are replaced, a thorough run-in operation is indispensable.

The recommended run-in schedule is as follows:

LOAD					SPEED	TIME
EY14	EY18-3	EY23	EY25-2	EY27-2		
NO LOAD					2,500 rpm	10 minutes
NO LOAD					3,000 rpm	10 minutes
NO LOAD					3,600 rpm	10 minutes
1.25 HP	1.75 HP	2.25 PS	2.5 HP	2.75 HP	3,600 rpm	30 minutes
2.5 HP	3.5 HP	4.5 PS	5 HP	5.5 HP	3,600 rpm	60 minutes

11. TROUBLE SHOOTING

For a satisfactory starting and running conditions of a gasoling engine, the following three requirements must be met:

1. The cylinder filled with a proper fuel-air mixture.
2. An appropriate compression in the cylinder.
3. Good spark at correct time to ignite the mixture.

If all three requirements are not met simultaneously, an engine can not be started. There are also other factors such as heavy load at starting and too long exhaust pipe causing high back pressure, which contribute to hard starting. The most common causes of engine troubles are given below.

11-1 STARTING DIFFICULTIES

11-1-1 FUEL SYSTEM

1) No gasoline in fuel tank, or fuel cock closed.
2) Carburetor insufficiently choked, especially when engine is cold.
3) Water, dirt or gum in gasoline hindering flow of fuel to carburetor.
4) Inferior or poor grade gasoline not vaporizing satisfactorily to produce correct fuel mixture.
5) Needle valve in carburetor held open by dirt or gum. This condition is ascertained by continuous fuel drip from the carburetor during idling.
   Sometimes, this trouble is remedied by lightly tapping the float chamber with a screw driver handle or the like.
6) Due to carburetor flooding, too much fuel introduced in the cylinder through cranking, making the mixture too rich to be ignited.
   When this happens, remove spark plug and turn the engine over several times with starting pulley to evacuate over-rich mixture through the plug hole. Keep carburetor choke open during this operation. Dry spark plug thoroughly and reinstall, and try to start again.

11-1-2 COMPRESSION SYSTEM

When the fuel system and the ignition system are eliminated as the cause of starting difficulties and loss of power, the following are to be checked for possible lack of compression.

1) Cylinder dry after long interruption of operation.
2) Loose or broken spark plug. In this case, a hissing noise is audible, during cranking, made by escaping mixture gas in compression stroke.
3) Damaged head gasket or slack cylinder head tightening. A similar hissing noise is produced during compression stroke.
4) Tappet clearance incorrect. (See "6-3-8, 4) Tappet Adjustment")

If the compression is not recovered after correcting the above faults, the engine must be partly dismantled and the following must be checked.

1) Valve stuck open due to carbon or gum on valve stem.
2) Piston rings stuck in piston due to carbon accumulation. Remove piston and connecting rod from engine and clean, correct or replace parts.

11-1-3 ELECTRIC SYSTEM

When there is no spark, the following must be checked.

1) Disconnected cable leading to ignition coil, spark plug or contact breaker.
2) Broken ignition coil winding, causing short circuit.
3) Wet or oil soaked spark plug cable.
4) Dirty or wet spark plug.
5) Incorrect spark plug electrode gap.
6) Short connection of spark plug electrodes.
7) Pitted or fused breaker points.
8) Sticking breaker arm.
9) Leaking or grounded condenser.
10) Incorrect ignition timing.

11-2 ENGINE MISSES

1) Incorrect spark plug electrode gap.
2) Worn and leaking ignition cable.
3) Weak spark.
4) Loose connections in ignition wire.
5) Pitted or worn breaker points.
6) Gasoline containing water.
7) Poor compression.

11-3 ENGINE STOPS

1) Fuel tank empty. Gasoline contaminated with water, dirt or gum.
2) Gasoline vaporized in fuel lines due to excessive heating around engine. (Vapor lock)
3) Vapor lock in fuel lines or carburetor due to the use of too volatile winter gas in the hot season.
4) Air vent hole in fuel tank cap plugged.
5) Seizure in rotating or sliding pairs in engine due to lack of oil.
6) Ignition troubles.

11-4 ENGINE OVERHEATS

1) Crankcase oil supply low. Replenish immediately.
2) Incorrect spark timing
3) Low grade gasoline is used.
   Engine overloaded.
4) Restricked cooling air circulation.
5) Cooling air partly misdirected causing loss to cooling efficiency.
6) Cylinder head cooling fins blocked with dirt.

7) Engine operated in closed space without fresh supply of cooling air.

8) Restricked exhaust gas outlet.
Carbon deposit in combustion space.

9) Engine detonating due to low octane gasoline with heavy load at low speed.

11-5 ENGINE KNOCKS

1) Gasoline of poor quality or low octane rating.

2) Engine operating under heavy load at low speed.

3) Carbon or lead deposits in cylinder head.

4) Incorrect spark timing.

5) Losse or burnt out connecting rod bearing.

6) Worn or loose piston pin.

7) Engine overheated.

11-6 ENGINE BACKFIRES THROUGH CARBURETOR

1) Water or dirt in gasoline or poor grade of gasoline.

2) Sticky intake valve.

3) Overheated valves, or hot carbon particles in engine.

4) Engine cold.

12. CHECKS and CORRECTIONS

After dismantling and cleaning the engine parts, check them, and if necessary, correct them, according to the correction table.

The correction table applies whenever the engines are repaired. Its contents should be thoroughly understood by those who undertake the repairing. Its specifications must be abided by to effect correct maintenance.

Below, terms employed in the correction table are explained.

1) CORRECTION

All operations performed on the engine parts for the purpose of improving or recovering the engine performance, consisting of repair, readjustment, and replacement.

2) STANDARD SIZE

Design dimension of the part without the tolerance.

3) CORRECTION TOLERANCE

Tolerance on the re-finished part dimension or on the readjustment dimension.

4) CORRECTION LIMIT

Limit on the part and adjustment, beyond which any dimensional and functional change, due to wear, burn and other causes will adversely affect the normal engine performance.

5) USE LIMIT

Limit, beyond which the part is no longer usable, due to defects in function or strength.

NOTE: All dimensions in the "13. CORRECTION TABLE" are given in millimeter, except where otherwise specified.

13. CORRECTION TABLE

ITEM		ENGINE MODEL	STANDARD SIZE	CORRECTION		USE LIMIT	REMARKS	TOOL	CORRECTION METHOD
				TOLERANCE	LIMIT				
Flatness of cylinder head		EY14 EY18-3 EY23 EY25-2 EY27-2		0.05	0.15			Surface plate, Feeler	Correct
Cylinder	Bore	EY14	S.T.D. 62 dia.	+0.018 0	0.15	1.15		Cylinder gauge	Boring
		EY18-3 EY23 EY25-2 EY27-2	65 dia. 68 dia. 72 dia. 74 dia.	+0.019 0					
	Roundness	EY14 EY18-3 EY23 EY25-2 EY27-2		0.01					
	Cylindricity	EY14 EY18-3 EY23 EY25-2 EY27-2		0.015					
	Valve seat contact width	EY14 EY18-3 EY23 EY25-2 EY27-2		1.2~1.5	2.5			Seat cutter	Correct
	Valve guide I.D.	EY14	6 dia.	+0.015	0.15	0.15	At middle portion	Cylinder gauge	Replace
		EY18-3 EY23 EY25-2 EY27-2	7 dia.	+0.036~+0.016	0.2	0.2			
Piston	O.D. at skirt, in thrust direction (over size)	EY14	S.T.D. 61.963 dia. B 62.213 dia. C 62.463 dia.	0 −0.02	−0.1	−0.1		Micro-meter	Replace
		EY18-3	S.T.D. 64.980 dia. B 64.230 dia. C 65.480 dia.						
		EY23	S.T.D. 67.970 dia. B 68.220 dia. C 68.470 dia.						
		EY25-2	S.T.D. 71.94 dia. B 72.19 dia. C 72.44 dia.						
		EY27-2	S.T.D. 73.928 dia. B 74.178 dia. C 74.428 dia.						
	Width of ring groove	EY14 EY18-3 EY25-2	Top 2.5 2nd 2.5 Oil 4.0	+0.025 0 EY18-3 Oil +0.035 0	0.15	0.15		Vernier calipers	Replace
		EY23	Top 2.0 2nd 2.0 Oil 2.8						
		EY27-2	Top 2.0 2nd 2.0 Oil 4.0						
	Piston pin hole	EY14 EY18-3 EY23	14 dia.	+0.002 −0.009	0.035	0.035		Cylinder gauge	Replace
		EY25-2 EY27-2	16 dia.						
	Clearance between piston and cylinder	EY14		0.037L~0.075L	0.025	0.025	Max. cylinder dia. and piston dia. at skirt in thrust direction	Cylinder gauge, Micro-meter	Replace
		EY18-3 EY23		0.030L~0.069L					
		EY25-2		0.06L~0.099L					
		EY27-2		0.072L~0.111L					

ITEM		ENGINE MODEL	STANDARD SIZE	CORRECTION		USE LIMIT	REMARKS	TOOL	CORRECTION METHOD
				TOLERANCE	LIMIT				
Piston	Clearance between piston ring and ring groove	EY14 EY25-2 EY27-2	Top 2nd Oil	0.050L~0.095L 0.040L~0.085L 0.010L~0.055L	0.15L	0.15		Feeler gauge	Replace
		EY18-3 EY23	Top 2nd Oil	0.050L~0.095L 0.040L~0.085L 0.010L~0.065L					
	Fit between piston & piston pin	EY14 EY18-3 EY23		0.009T~0.010L	0.06L	0.06L		Cylinder gauge Micro-meter	Replace
		EY25-2 EY27-2		0.004T~0.015L					
Piston Ring	Ring gap	EY14	Top 2nd Oil	0.20~0.40	1.5	1.5		Feeler gauge	Replace
		EY18-3 EY23 EY25-2 EY27-2		0.05~0.25					
	Ring width	EY14	Top 2.5 2nd 2.5 Oil 4.0	−0.05~−0.07 −0.04~−0.060 −0.01~−0.03	−0.1	−0.1		Micro-meter	Replace
		EY18-3 EY25-2 EY27-2		−0.05~−0.07 −0.04~−0.06 −0.01~−0.03					
		EY23	Top 2.0 2nd 2.0 Oil 2.8						
Piston pin O.D.		EY14 EY18-3 EY23	14 dia.	0 −0.008	−0.04	−0.04		Micro-meter	Replace
		EY25-2 EY27-2	16 dia.	−0.005 −0.013					
Connecting Rod	Large end I.D.	EY14	24 dia.	+0.013 0	0.1	0.1		Cylinder gauge	Replace
		EY18-3 EY23	26 dia.						
		EY25-2 EY27-2	28 dia.						
	Clearance between rod large end I.D. and crankpin	EY14		0.05L~0.076L	0.2	0.2		Cylinder gauge Micro-meter	Replace
		EY18-3 EY23		0.037L~0.063L					
		EY25-2 EY27-2		0.04L~0.066L					
	Small end I.D.	EY14 EY18-3 EY23	14 dia.	+0.021~+0.01	0.08	0.08		Cylinder gauge	Replace
		EY25-2 EY27-2	16 dia.	+0.027~+0.016					
	Clearance between small end I.D. and piston pin	EY14 EY18-3 EY23		0.01L~0.029L	0.12	0.12		Cylinder guage Micro-meter	Replace
		EY25-2 EY27-2		0.021L~0.040L					
	Large end side clearance	EY14		0.2L~0.7L	1.0	1.0		Feeler gauge	Re-machine or Replace
		EY18-3 EY23 EY25-2 EY27-2		0.1L~0.3L					
	Parallelism between large end and small end bores	EY14		0.1	0.1	0.1		Test bar & Dial indicator	Re-machine or Replace
		EY18-3 EY23 EY25-2 EY27-2		0.05					
	Distance between large end and small end bores	EY14	85	+0.1 −0.1		0.15			
		EY18-3 EY23	100						
		EY25-2 EY27-2	110						

ITEM		ENGINE MODEL	STANDARD SIZE	CORRECTION		USE LIMIT	REMARKS	TOOL	CORRECTION METHOD
				TOLERANCE	LIMIT				
Crankshaft	Crankpin O.D.	EY-14	24 dia.	−0.050~0.063	0.15	0.15		Micro-meter	Re-machine or Replace
		EY18-3 EY23	26 dia.	−0.037~0.050					
		EY25-2 EY27-2	28 dia.	−0.040~0.053					
	Crankpin O.D. roundness	EY14 EY18-3 EY23 EY25-2 EY27-2		below 0.005				Micro-meter	
	Crankpin O.D. cylindricity	EY14 EY18-3 EY23 EY25-2 EY27-2		below 0.005				Micro-meter	
	Crankpin O.D. parallelism	EY14 EY18-3 EY23 EY25-2 EY27-2		below 0.008				Dial indicator	
	Crankshaft journal O.D.	EY14	Drive s. 22 dia. Mag. s. 20 dia.	−0.003~−0.012	−0.05	−0.05		Micro-meter	Replace
		EY18-3 EY23	Drive s. Mag. s. 25 dia.						
		EY25-2 EY27-2	Drive s. Mag. s. 30 dia	−0.003~−0.012 −0.009~0					
Camshaft	Cam lobe height	EY14	24.95	±0.1	−0.25	−0.25		Micro-meter	Replace
		EY18-3 EY23 EY25-2 EY27-2	30.8						
	Journal O.D.	EY14B	Drive s. 22 dia. Mag. s. 15 dia.	−0.003~−0.012 −0.016~−0.027	0.05	0.05		Micro-meter	Replace
		EY14D	Drive s. Mag. s. 15 dia.	−0.016~−0.027					
		EY18-3B EY23B	Drive s. 25 dia. Mag. s. 17 dia.	−0.003~−0.012 −0.016~−0.027					
		EY18-3D EY23D	Drive s. Mag. s. 17 dia.	−0.016~−0.027					
		EY25-2B EY27-2B	Drive s. 30 dia. Mag. s. 20 dia.	−0.003~−0.012	0.05	0.05			
		EY25-2D EY27-2D	Drive s. 15 dia. Mag. s. 15 dia.	−0.032~−0.043					
Valve spring	Free length	EY14	32		−1.5			Vernier calipers	Replace
		EY18-3 EY23 EY25-2 EY27-2	36						
	Squareness	EY14 EY18-3 EY23 EY25-2 EY27-2				1.0	For total length	Square	Replace
Intake & Exhaust Valves	Valve stem O.D.	EY14	Intake Exhaust 6 dia.	−0.025~−0.040 −0.075~−0.095	−0.15	−0.15		Micro-meter	Replace
		EY18-3 EY23 EY25-2 EY27-2	Intake Exhaust 7 dia.	−0.040~−0.062					
	Clearance between stem and guide	EY14	Intake Exhaust	0.025L~0.055L 0.075L~0.110L	0.3	0.3	At middle	Cylinder gauge	Replace
		EY18-3 EY23 EY25-2 EY27-2	Intake Exhaust	0.056L~0.098L					

	ITEM	ENGINE MODEL	STANDARD SIZE	CORRECTION		USE LIMIT	REMARKS	TOOL	CORRECTION METHOD
				TOLERANCE	LIMIT				
Intake & Exhaust Valves	Tappet clearance	EY14		0.10L~0.14L	below 0.05 above 0.25			Feeler gauge	Correct
		EY18-3 EY23 EY25-2 EY27-2		0.16L~0.20L					
	Clearance between groove and retainer	EY14 EY18-3 FY23	2.5	0.04L~0.12L	0.5	0.5		Feeler gauge	Correct
		EY25-2 EY27-2	2.5	0.04L~0.15L					
	Stem end length	EY14 EY18-3 EY23 EY25-2 EY27-2	4.0		−2.0	−2.0		Venier calipers	Replace
Tappet	Total length	EY14	38.12	0 ~ +0.06	−0.5	−0.5		Venier calipers	Replace
		EY18-3 EY23	46						
		EY25-2 EY27-2	50.9	±0.05					
	Clearance between stem and guide	EY14		0.013L~0.037L	0.2	0.2		Cylinder gauge & Micro-meter	Replace
		EY18-3 EY23 EY25-2 EY27-2		0.025L~0.062L					
Carburetor	Metering needle unscrew	EY14 EY18-3 EY23 EY25-2 EY27-2	Fixed	±1/4					
	Pilot screw unscrew	EY14	1						
		EY18-3	BV18 2 BV21 1						
		EY23	BV21 1-3/8						
		EY25-2 EY27-2	1-5/8 1-1/2						
Electric Device	Spark plug	EY14 EY18-3 EY25-2 EY27-2	NGK B-6HS						
		EY23	NGK BP-4HS						
	Spark gap	EY14 EY18-3 EY23 EY25-2 EY27-2		0.6~0.7	1			Feelder gauge	Adjust or Replace
	Spark timing	EY14 EY18-3 EY23 EY25-2 EY27-2	23° before T.D.C.	±3°	±5°			Timing tester	Adjust
	Point opening	EY14 EY18-3	0.4	±0.1	±0.1			Contact breaker spanner	Adjust
		EY25-2 EY27-2	0.35	±0.05					

ITEM	MODEL	HP/rpm	CORRECTION LIMIT	REMARKS
Max. Output	EY14D	3.5/4,000	Below 110% of rated output	
	EY18-3D	5.0/4,000		
	EY23D	6.0/4,000		
	EY25-2D	7.0/4,000		
	EY27-2D	7.5/4,000		
Continuous Rated Output	EY14D	2.5/3,600		
	EY18-3D	3.5/3,600		
	EY23D	4.5/3,600		
	EY25-2D	5.0/3,600		
	EY27-2D	5.5/3,600		

ITEM	MODEL	liter/hr	REMARKS
Fuel Consumption	EY14	1.0	
	EY18-3	1.5	
	EY23	1.9	
	EY25-2	2.2	
	EY27-2	2.3	

ITEM	MODEL	cc/hr	USE LIMIT cc/hr	REMARKS
Lubricant Consumption	EY14	15	50	
	EY18-3	15	50	
	EY23	15	50	
	EY25-2	28	60	
	EY27-2	30		

ITEM	MODEL	liter	REMARKS
Special Lubricant Quality	EY14	0.50	Use the class SC or higher grade Engine Oil Below −10°C (14°F) SAE 10W-30 −10°C (14°F) ~ 20°C (68°F) SAE #20 20°C (68°F) ~ 40°C (104°F) SAE #30
	EY18-3	0.70	
	EY23	0.65	
	EY25-2	0.85	
	EY27-2		

ITEM	MODEL	FREQUENCY OF OIL CHANGING
Oil Change	EY14 EY18-3 EY23 EY25-2 EY27-2	First Time: Change oil after 20 hours operation. Second Time and Thereafter: Change oil every 50 hours operation.

ITEM	MODEL	kg/cm²/rpm	CORRECTION LIMIT	TOOL
Cylinder Pressure	EY14	4.6/420	70% of normal value	Pressure gauge
	EY18-3	5.9/360		
	EY23	6.7/380		
	EY25-2	5.5/420		
	EY27-2	5.5/420		

ITEM	MODEL	rpm	TOOL	REMARKS
Min. accelerating revolution	EY14D EY18-3D EY23D EY25-2D EY27-2D	1,200~1,300	Tachometer	
	EY14B EY18-3B EY23B EY25-2B EY27-2B	600~650		

ITEM		MODEL	kg-cm	ft-lb	TOOL	REMARKS
Tightening Torque	Cylinder head clamp nuts	EY14	190~230	13.7~16.6	Torque wrench	
		EY18-3 EY23	330~360	23.8~25.9		
		EY25-2 EY27-2	340~370	24.6~26.7		
	Connecting rod bolts	EY14	90~115	6.5~8.3	Torque wrench	
		EY18-3 EY23	170~200	12.3~14.4		
		EY25-2 EY27-2	200~250	14.4~18.0		
	Magneto clamp nuts	EY14	450~500	32.6~36.1	Torque wrench	
		EY18-3 EY23 EY25-2 EY27-2	600~650	43.5~47.0		
	Main bearing cover bolts	EY14	80~100	5.8~7.2	Torque wrench	
		EY18-3 EY23 EY25-2 EY27-2	170~190	12.3~13.7		
	Spark plug	EY14	250~290		Torque wrench	
		EY18-3 EY23	230~270	16.6~19.5		
		EY25-2 EY27-2	260~300	18.8~21.7		

14. MAINTENANCE and STORING

The following maintenance jobs apply when the engine is operated correctly under normal conditions. The indicated maintenance intervals are by no means guarantees for maintenance free operations during these intervals.

For example, if the engine is operated in extremely dusty conditions, the air cleaner should be cleaned every day, instead of every 50 hours.

14-1 DAILY CHECKS and MAINTENANCE (EVERY 8 HOURS)

Checks and maintenance	Reasons for requiring them
Remove dust from whatever parts which accumulated dust.	The governor linkage is especially susceptible to dust.
Check external fuel leakage. If any, re-tighten or replace.	Not only wasteful but also dangerous
Check screw tightening. If any loose one is found, re-tighten.	Loose screws and nuts will result in vibration accidents.
Check oil level in crankcase and add up as necessary.	If the engine is operated without sufficient oil, it will fail.

14-2 EVERY 20 HOURS CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Change crankcase oil.	To remove run-in wear particles.

14-3 EVERY 50 HOURS (10 DAY) CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Change crankcase oil.	Contaminated oil accelerates wear.
Clean air cleaner	Clogged air cleaner harms engine operation.
Check spark plug. If contaminated, wash in gasoline or polish with emery paper.	Output power is reduced and starting is made difficult.

14-4 EVERY 100 - 200 HOURS (MONTHLY) CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Clean fuel filter and fuel tank.	The engine will be out of order.
Clean contact breaker points.	The engine output drops.

14-5 EVERY 500 – 600 HOURS (SEMIANUAL) CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Remove cylinder head and remove carbon deposit.	The engine will be out of order.
Disassemble and clean carburetor.	

14-6 EVERY 1000 HOURS (YEARLY) CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Perform overhauls, clean correct or replace parts.	The engine output drops and become out of order.
Change piston rings	
Replace fuel pipe once a year.	To prevent from danger caused by the fuel leakage.

14-7 PREPARATION for LONG-TERM STORAGE

1) Perform the above 13-1 and 13-2 maintenance jobs.
2) Drain fuel from the fuel tank and carburetor float chamber.
3) To prevent rust in the cylinder bore, apply oil through the spark plug hole and turn the crankshaft several turns by hand. Re-install the plug.
4) Turn the starting pulley by hand and leave it where the resistance is the heaviest.
5) Clean the engine outside with oiled cloth.
6) Put a vinyl or other cover over the engine and store the engine in dry place.

Industrial Engines

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